

4.0 Radiological Status of the Muskogee Site

In 1993, a characterization survey was performed at the Fansteel Muskogee site to determine existing site conditions. Radiological survey activities were conducted over the interior and exterior of the site structures and the external open land areas of the Fansteel site. Results of this study are presented in this section. While the characterization event occurred about a decade ago, Fansteel believes that the data remain representative of current site conditions and are, therefore, suitable for DP purposes. Fansteel's belief is based primarily on the fact that site operations since 1992 have been largely limited to asset maintenance and preservation. Nonetheless, the remedial action and FSS protocols being proposed by Fansteel in this DP offer the needed flexibility to properly identify and respond to site conditions that significantly depart from the DP planning basis described in this section.

4.1 Survey Descriptions

Surveys were performed on building exterior surfaces, building interior surfaces, and equipment. Measurements of total (fixed + removable) alpha contamination in disintegrations per minute per 100 square centimeters (dpm/100 cm²), total beta/gamma contamination (dpm/100 cm²), and gross gamma in counts per minute (cpm) were obtained on contact and at 1 m above the surface. These surveys were performed to identify buildings, portions of buildings, and equipment that could require decontamination or disposal during decommissioning activities. No radionuclide-specific analyses were performed during the 1992 survey, nor were exposure rates measured inside structures.

External open land areas of the Fansteel property, including paved areas, roads, and concrete pads, were surveyed to identify areas of surficial radioactive contamination and to indicate the possible presence of subsurface radioactivity. Measurements of alpha (dpm/100 cm²), beta (dpm/100 cm²), and gross gamma (cpm) radioactivity were obtained at the ground surface at designated points covering the entire area of land occupied by Fansteel. Additionally, gross gamma measurements were recorded at 1 m above the ground surface.

Additional surface and subsurface investigations conducted at the Fansteel facility included installation and sampling of soil borings, groundwater monitoring wells, test pits, and sampling of surface water and sediments. Soil samples were collected at certain survey points that exhibited elevated radioactivity with respect to background. Laboratory analyses were performed on surface and subsurface samples of soils, sediments, surface water, groundwater, and pond residues. The samples were analyzed for gross alpha radioactivity, gross beta radioactivity, and radionuclides of interest; namely, total uranium (²³⁴U, ²³⁵U, and

^{238}U), total thorium (^{228}Th , ^{230}Th , and ^{232}Th), ^{226}Ra (^{238}U decay series daughter), and ^{228}Ra (^{232}Th decay series daughter). All analytical results of soils and sediments were reported in appropriate activity concentration units.

The following sections describe the radiological status of the structures (including components), surface and subsurface soil, surface water and sediments, site storage ponds and residues, and groundwater. Refer to Figure 4-1 for the location of buildings, ponds, and sample locations.

4.2 Impacted Structure and Component Characterization

Licensed activities occurred in a majority of the structures at the Muskogee site located on the south and east plant portions of the property. These structures, therefore, contain, or potentially contain, residual licensed radioactive material and are characterized “impacted” for purposes of an initial radiological characterization:

- Chemical “C” Building (Building No. 13)
- Chemical “A” Building (Building No. 16)
- Thermite Building (Building No. 9)
- Sodium Reduction Building (Building No. 11)
- R&D Laboratory Building (Building No. 15)
- Groundwater Treatment Facility (former Gunch House)
- Bertha Building (Building No. 12)
- Weir Building (Building No. 10)
- Ore Storage Pad

Licensed activities did not occur in the following structures; they are, therefore, characterized as “nonimpacted” for purposes of an initial radiological characterization:

- New Maintenance Building (Machine Shop)
- Chemical Equipment Room (Building No. 17)
- Pond No. 3 Pump Motor Control Center (Building No. 19)
- Chemical “C” Building Power Control Room (Building No. 20)
- White House (Building No. 7)

The following impacted structures no longer exist at the Muskogee site, but were surveyed for radiological contamination in 1992 during performance of the remediation assessment:

- Bulk Sodium Building, Old Maintenance Building (Building No. 8)
- Electrical Control Building for Lime Neutralization (Building No. 14)
- Contractor’s Tool Crib (Building No. 18)

- Old White House (Building No. 7)
- Gunch House

For the existing and removed impacted structures, radioactivity surveys were conducted over exterior surfaces of buildings using a 1-m² grid system to establish survey cell boundaries. At least 5 percent of the available cells were surveyed in 1992 with the following measurements:

- Three measurements of total beta/gamma contamination (dpm/100 cm²) consisting of a single 1-minute count at the surface of the upper right-hand quadrant, the center, and the lower left-hand quadrant.
- One measurement of total alpha contamination (dpm/100 cm²) consisting of a single 1-minute count at the surface of the center of the square.
- One measurement of gamma activity in cpm consisting of a single 1-minute count at the surface of the center of the square.
- One measurement of gamma activity (cpm) 1 m away from the center of the survey cell.

The measurement of alpha and beta/gamma contamination was reported in 1993 as net dpm/100 cm² after subtracting the appropriate background count rate from the gross count rate and converting the difference to dpm/100 cm² using the appropriate detection efficiency factors. No analyses were performed to identify radionuclides of interest present on structure or component surfaces, nor were swipe samples taken to identify removable fractions.

The same survey grid, instruments, measurement techniques, and data reporting conventions were used for the interior building surface surveys. However, a higher density (11 percent) of the available cells was surveyed. Equipment and furnishings (i.e., components) located inside the buildings were also surveyed. Since a regularly spaced grid could not be established for most components due to their size and/or shape, measurement locations were arbitrarily assigned such that each identified component was measured for surficial radioactivity. One set of component measurements was obtained for every 4 m² of surface area. No measurements of radioactivity on internal surfaces of components were made. No building or component exposure rate measurements were documented during the 1992 surveys.

In the next subsections, a catalog of the initial radiological characterization measurement results for the existing impacted Muskogee site structures and components is presented. At the end of each characterization catalog, a description of the structure and components and a reference to its characterization map are provided.

4.2.1 Chemical "C" Building (Building No. 13)

4.2.1 Chemical "C" Building (Building No. 13)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	35	35	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	878	769	Note 1
Capped Vent	Gamma	contact cpm	25,155	25,155	6,192
	Gamma	1-meter cpm	25,910	25,910	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	111	111	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	939	822	Note 1
Capped Vent	Gamma	contact cpm	21,598	21,598	6,192
	Gamma	1-meter cpm	21,335	21,335	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	39	39	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	922	807	Note 1
Capped Vent	Gamma	contact cpm	24,442	24,442	6,192
	Gamma	1-meter cpm	23,425	23,425	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	114	114	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,328	946	Note 1
Fan Vent	Gamma	contact cpm	25,876	24,477	6,192
	Gamma	1-meter cpm	23,613	23,150	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	86	86	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	800	759	Note 1
Scrubber Pipe	Gamma	contact cpm	23,407	23,407	6,192
	Gamma	1-meter cpm	23,048	23,048	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	78	61	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	661	573	Note 1
Fan Vent	Gamma	contact cpm	20,446	17,299	6,192
	Gamma	1-meter cpm	20,319	17,547	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	117	78	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	483	424	Note 1
Fan Vent	Gamma	contact cpm	14,353	14,050	6,192
	Gamma	1-meter cpm	14,694	14,581	6,192
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.1 Chemical "C" Building (Building No. 13)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
6	Alpha	ndpm/100 cm ²	4,942	2,533	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	70,179	3,568	Note 1
Sump	Gamma	contact cpm	439,659	243,538	6,507
	Gamma	1-meter cpm	334,722	172,323	6,507
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	656	70	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	6,750	1,559	Note 1
Exterior	Gamma	contact cpm	171,826	28,522	7,755
	Gamma	1-meter cpm	101,094	28,729	7,755
Contamination Mode	Surface (penetration is unlikely but unknown)				
8	Alpha	ndpm/100 cm ²	9,490	980	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	208,548	20,402	Note 1
	Gamma	contact cpm	176,761	40,408	7,311
	Gamma	1-meter cpm	106,875	33,372	7,311
Contamination Mode	Surface (penetration is unlikely but unknown)				
9	Alpha	ndpm/100 cm ²	859	61	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	33,172	2,679	Note 1
	Gamma	contact cpm	60,631	20,444	7,397
	Gamma	1-meter cpm	36,723	19,319	7,397
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. Contains a single room with a concrete ceiling that formerly housed the ore digestion/extraction process in several tanks. This process used HF and an organic solvent; process tails were sent to Pond Nos. 2 and 3. The lower walls are transite and upper walls are corrugated fiberglass. The floor consists of a newer 8-inch concrete pour over the previous concrete foundation.				
Characterization Map	Figure 4-2				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.2.2 Chemical "A" Building (Building No. 16)

4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	253	253	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	3,133	3,067	Note 1
Vent	Gamma	contact cpm	25,978	25,978	6,818
	Gamma	1-meter cpm	29,167	29,167	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	173	58	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	990	372	Note 1
Vent	Gamma	contact cpm	15,936	13,735	6,818
	Gamma	1-meter cpm	17,526	15,666	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	7	7,372	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	729	591	Note 1
Air Conditioner	Gamma	contact cpm	15,304	15,304	6,818
	Gamma	1-meter cpm	17,975	17,975	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	27	27	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	976	884	Note 1
Vent	Gamma	contact cpm	13,092	13,092	6,818
	Gamma	1-meter cpm	13,841	13,841	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	7	2	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	1,971	996	Note 1
Vent	Gamma	contact cpm	21,375	13,973	6,818
	Gamma	1-meter cpm	20,794	17,435	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	53	46	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	448	336	Note 1
Vent	Gamma	contact cpm	12,904	12,581	6,818
	Gamma	1-meter cpm	11,980	11,863	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	113	113	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	667	517	Note 1
Vent	Gamma	contact cpm	12,478	12,478	6,818
	Gamma	1-meter cpm	12,518	12,518	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
8	Alpha	ndpm/100 cm ²	53	53	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	233	100	Note 1
Vent	Gamma	contact cpm	11,818	11,818	6,818
	Gamma	1-meter cpm	13,391	13,391	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
9	Alpha	ndpm/100 cm ²	73	27	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	662	183	Note 1
Vent	Gamma	contact cpm	13,955	11,999	6,818
	Gamma	1-meter cpm	15,590	13,722	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
10	Alpha	ndpm/100 cm ²	67	37	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	248	78	Note 1
Vent	Gamma	contact cpm	12,652	11,999	6,818
	Gamma	1-meter cpm	14,791	14,077	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
11	Alpha	ndpm/100 cm ²	60	60	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Scrubber Pipe	Gamma	contact cpm	10,023	10,023	6,818
	Gamma	1-meter cpm	10,488	10,488	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
12	Alpha	ndpm/100 cm ²	73	73	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	362	318	Note 1
Vent	Gamma	contact cpm	10,128	10,128	6,818
	Gamma	1-meter cpm	12,362	12,362	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
13	Alpha	ndpm/100 cm ²	233	130	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	481	170	Note 1
Vent	Gamma	contact cpm	14,645	12,701	6,818
	Gamma	1-meter cpm	15,241	13,079	6,818
Contamination Mode	Surface (penetration is unknown)				
14	Alpha	ndpm/100 cm ²	27	16	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	243	79	Note 1
Vent	Gamma	contact cpm	21,376	13,920	6,818
	Gamma	1-meter cpm	14,140	13,705	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
15	Alpha	ndpm/100 cm ²	53	53	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Scrubber Pipe	Gamma	contact cpm	10,087	10,087	6,818
	Gamma	1-meter cpm	10,508	10,508	6,818
Contamination Mode	Surface (penetration is unlikely but unknown)				
16	Alpha	ndpm/100 cm ²	75	69	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	1,035	738	Note 1
Vent	Gamma	contact cpm	10,057	9,760	8,090
	Gamma	1-meter cpm	10,872	10,704	8,090
Contamination Mode	Surface (penetration is unlikely but unknown)				
17	Alpha	ndpm/100 cm ²	38	32	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	1,209	888	Note 1
Vent	Gamma	contact cpm	10,608	10,556	8,090
	Gamma	1-meter cpm	11,231	10,440	8,090
Contamination Mode	Surface (penetration is unlikely but unknown)				
18	Alpha	ndpm/100 cm ²	90	74	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	521	271	Note 1
Vent	Gamma	contact cpm	17,462	13,769	6,927
	Gamma	1-meter cpm	17,757	14,965	6,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
19	Alpha	ndpm/100 cm ²	71	71	Note 1
Exterior Boiler	Beta/Gamma	ndpm/100 cm ²	37	12	Note 1
Room Vent	Gamma	contact cpm	10,279	10,279	6,972
	Gamma	1-meter cpm	10,989	10,989	6,972
Contamination Mode	Surface (penetration is unlikely but unknown)				
20	Alpha	ndpm/100 cm ²	62	31	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Vent	Gamma	contact cpm	12,814	11,743	6,972
	Gamma	1-meter cpm	12,730	12,426	6,972
Contamination Mode	Surface (penetration is unlikely but unknown)				
21	Alpha	ndpm/100 cm ²	10	5	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Vent Stack	Gamma	contact cpm	8,915	8,777	6,922
	Gamma	1-meter cpm	11,436	10,849	6,922
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
22	Alpha	ndpm/100 cm ²	29	29	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Vent	Gamma	contact cpm	9,332	9,332	6,922
	Gamma	1-meter cpm	10,367	10,367	6,922
Contamination Mode	Surface (penetration is unknown)				
23	Alpha	ndpm/100 cm ²	19	19	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	95	58	Note 1
Vent	Gamma	contact cpm	9,953	9,953	6,922
	Gamma	1-meter cpm	9,702	9,702	6,922
Contamination Mode	Surface (penetration is unknown)				
24	Alpha	ndpm/100 cm ²	33	33	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	168	152	Note 1
Vent	Gamma	contact cpm	9,278	9,278	6,922
	Gamma	1-meter cpm	10,781	10,781	6,922
Contamination Mode	Surface (penetration is unlikely but unknown)				
25	Alpha	ndpm/100 cm ²	283	93	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	688	141	Note 1
DRAVO	Gamma	contact cpm	7,707	6,408	8,283
	Gamma	1-meter cpm	7,927	6,658	8,283
Contamination Mode	Surface (penetration is unlikely but unknown)				
26	Alpha	ndpm/100 cm ²	394	74	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	7,680	671	Note 1
DRAVO Metal	Gamma	contact cpm	8,657	7,333	7,950
Heater	Gamma	1-meter cpm	8,307	7,512	7,950
Contamination Mode	Surface (penetration is unlikely but unknown)				
27	Alpha	ndpm/100 cm ²	593	166	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	5,548	1,482	Note 1
Big Bertha	Gamma	contact cpm	11,628	7,706	7,950
	Gamma	1-meter cpm	12,618	7,830	7,950
Contamination Mode	Surface (penetration is unknown)				
28	Alpha	ndpm/100 cm ²	380	305	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	6,452	3,806	Note 1
Scrubber	Gamma	contact cpm	25,492	16,760	8,745
	Gamma	1-meter cpm	20,641	16,447	8,745
Contamination Mode	Surface (penetration is unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
29	Alpha	ndpm/100 cm ²	125	73	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	935	404	Note 1
Air Compressor	Gamma	contact cpm	5,093	4,579	6,142
	Gamma	1-meter cpm	6,010	5,809	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
30	Alpha	ndpm/100 cm ²	263	177	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	525	280	Note 1
Air Compressor	Gamma	contact cpm	4,667	4,186	6,142
	Gamma	1-meter cpm	5,608	5,192	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
31	Alpha	ndpm/100 cm ²	88	63	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	320	85	Note 1
Air Compressor	Gamma	contact cpm	3,591	3,547	6,142
	Gamma	1-meter cpm	4,783	4,677	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
32	Alpha	ndpm/100 cm ²	106	66	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Drake Press	Gamma	contact cpm	5,051	4,555	6,142
	Gamma	1-meter cpm	5,303	4,877	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
33	Alpha	ndpm/100 cm ²	6	6	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Tank	Gamma	contact cpm	5,117	5,117	6,142
	Gamma	1-meter cpm	5,135	5,135	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
34	Alpha	ndpm/100 cm ²	138	72	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	510	233	Note 1
Tank	Gamma	contact cpm	5,956	5,518	6,142
	Gamma	1-meter cpm	6,332	5,532	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
35	Alpha	ndpm/100 cm ²	25	13	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Boiler	Gamma	contact cpm	4,722	4,219	6,142
	Gamma	1-meter cpm	5,192	4,734	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
36	Alpha	ndpm/100 cm ²	231	122	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	575	214	Note 1
Tank	Gamma	contact cpm	4,722	4,405	6,142
	Gamma	1-meter cpm	5,161	4,817	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
37	Alpha	ndpm/100 cm ²	125	82	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	240	74	Note 1
Welder	Gamma	contact cpm	5,593	4,947	6,142
	Gamma	1-meter cpm	6,083	5,257	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
38	Alpha	ndpm/100 cm ²	88	72	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Pipe Threader	Gamma	contact cpm	4,500	4,285	6,142
	Gamma	1-meter cpm	4,571	4,501	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
39	Alpha	ndpm/100 cm ²	81	56	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	300	122	Note 1
Pipe Threader	Gamma	contact cpm	4,059	4,054	6,142
	Gamma	1-meter cpm	4,871	4,190	6,142
Contamination Mode	Surface (penetration is unlikely but unknown)				
40	Alpha	ndpm/100 cm ²	131	72	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	30	5	Note 1
Welder	Gamma	contact cpm	4,180	4,180	6,142
	Gamma	1-meter cpm	4,787	4,787	6,142
Contamination Mode	Surface (penetration is unknown)				
41	Alpha	ndpm/100 cm ²	106	37	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	400	78	Note 1
Boiler	Gamma	contact cpm	7,442	5,027	5,927
	Gamma	1-meter cpm	5,957	4,864	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
42	Alpha	ndpm/100 cm ²	124	62	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	329	127	Note 1
Tank	Gamma	contact cpm	4,780	4,199	5,927
	Gamma	1-meter cpm	4,757	4,518	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
43	Alpha	ndpm/100 cm ²	82	50	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Small Hot Well	Gamma	contact cpm	5,710	5,501	5,927
	Gamma	1-meter cpm	5,568	5,313	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
44	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Compressor	Gamma	contact cpm	5,147	5,147	5,927
	Gamma	1-meter cpm	5,820	5,820	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
45	Alpha	ndpm/100 cm ²	12	6	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	172	81	Note 1
Refrigerated Air	Gamma	contact cpm	5,512	5,175	5,927
Dryer	Gamma	1-meter cpm	5,758	5,607	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
46	Alpha	ndpm/100 cm ²	12	6	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	106	18	Note 1
Caustic Soda	Gamma	contact cpm	4,572	4,166	5,927
Tank	Gamma	1-meter cpm	5,562	5,033	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
47	Alpha	ndpm/100 cm ²	44	25	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Anion No. 1	Gamma	contact cpm	5,733	4,474	8,852
Tank	Gamma	1-meter cpm	7,790	6,985	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
48	Alpha	ndpm/100 cm ²	25	13	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Cation No. 1	Gamma	contact cpm	5,095	4,022	8,852
Tank	Gamma	1-meter cpm	7,193	6,918	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
49	Alpha	ndpm/100 cm ²	10	5	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Anion No. 2	Gamma	contact cpm	5,306	3,988	8,852
Tank	Gamma	1-meter cpm	7,109	6,367	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
50	Alpha	ndpm/100 cm ²	5	3	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Hydrochloric Acid Tank	Gamma	contact cpm	5,414	5,174	8,852
	Gamma	1-meter cpm	6,055	5,560	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
51	Alpha	ndpm/100 cm ²	59	37	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	323	54	Note 1
Cation No. 2 Tank	Gamma	contact cpm	4,979	3,942	8,852
	Gamma	1-meter cpm	7,044	6,073	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
52	Alpha	ndpm/100 cm ²	35	18	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	452	75	Note 1
Softener No. 1 Tank	Gamma	contact cpm	4,732	3,854	8,852
	Gamma	1-meter cpm	7,116	6,411	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
53	Alpha	ndpm/100 cm ²	30	15	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Softener No. 2 Tank	Gamma	contact cpm	4,736	4,096	8,852
	Gamma	1-meter cpm	7,097	6,595	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
54	Alpha	ndpm/100 cm ²	49	27	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	516	86	Note 1
Salt Water Tank	Gamma	contact cpm	6,645	5,491	8,852
	Gamma	1-meter cpm	7,111	6,656	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
55	Alpha	ndpm/100 cm ²	235	160	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	267	71	Note 1
Air Compressor	Gamma	contact cpm	4,515	4,036	5,927
	Gamma	1-meter cpm	4,676	4,070	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
56	Alpha	ndpm/100 cm ²	100	50	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Control Box	Gamma	contact cpm	5,090	4,558	5,927
	Gamma	1-meter cpm	5,067	4,819	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
57	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Round Sump	Gamma	contact cpm	3,551	3,551	5,927
	Gamma	1-meter cpm	3,967	3,967	5,927
Contamination Mode	Surface (penetration is unlikely but unknown)				
58	Alpha	ndpm/100 cm ²	300	177	Note 1
Room 110	Beta/Gamma	ndpm/100 cm ²	1,713	553	Note 1
Tank	Gamma	contact cpm	443	394	290
	Gamma	1-meter cpm	421	393	290
Contamination Mode	Surface (penetration is unlikely but unknown)				
59	Alpha	ndpm/100 cm ²	71	71	Note 1
Room 110	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Fountain	Gamma	contact cpm	194	194	290
	Gamma	1-meter cpm	288	288	290
Contamination Mode	Surface (penetration is unlikely but unknown)				
60	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 111	Beta/Gamma	ndpm/100 cm ²	492	457	Note 1
Sink	Gamma	contact cpm	12,918	12,918	9,533
	Gamma	1-meter cpm	12,583	12,583	9,533
Contamination Mode	Surface (penetration is unlikely but unknown)				
61	Alpha	ndpm/100 cm ²	29	15	Note 1
Room 303	Beta/Gamma	ndpm/100 cm ²	191	130	Note 1
Stock Sampler	Gamma	contact cpm	8,177	8,167	8,293
	Gamma	1-meter cpm	8,960	8,689	8,293
Contamination Mode	Surface (penetration is unlikely but unknown)				
62	Alpha	ndpm/100 cm ²	33	14	Note 1
Room 311	Beta/Gamma	ndpm/100 cm ²	591	222	Note 1
Powder Room	Gamma	contact cpm	3,866	3,756	2,693
Heater	Gamma	1-meter cpm	4,0454	3,617	2,693
Contamination Mode	Surface (penetration is unlikely but unknown)				
63	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 313	Beta/Gamma	ndpm/100 cm ²	2,527	2,527	Note 1
Sink	Gamma	contact cpm	4,649	4,649	2,619
	Gamma	1-meter cpm	4,524	4,524	2,619
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
64	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 313	Beta/Gamma	ndpm/100 cm ²	1,882	1,792	Note 1
Sink	Gamma	contact cpm	4,156	4,156	2,619
	Gamma	1-meter cpm	3,765	3,765	2,619
Contamination Mode	Surface (penetration is unlikely but unknown)				
65	Alpha	ndpm/100 cm ²	33	33	Note 1
Room 313	Beta/Gamma	ndpm/100 cm ²	323	108	Note 1
Heater	Gamma	contact cpm	3,620	3,620	2,619
	Gamma	1-meter cpm	3,506	3,506	2,619
Contamination Mode	Surface (penetration is unlikely but unknown)				
66	Alpha	ndpm/100 cm ²	50	50	Note 1
Room 315	Beta/Gamma	ndpm/100 cm ²	841	761	Note 1
Sink	Gamma	contact cpm	10,468	10,468	8,512
	Gamma	1-meter cpm	10,373	10,373	8,512
Contamination Mode	Surface (penetration is unlikely but unknown)				
67	Alpha	ndpm/100 cm ²	48	36	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	484	81	Note 1
Electric Panel	Gamma	contact cpm	5,999	5,755	4,780
	Gamma	1-meter cpm	6,006	5,856	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
68	Alpha	ndpm/100 cm ²	33	24	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Transformer	Gamma	contact cpm	5,541	5,298	4,780
Power Supply	Gamma	1-meter cpm	6,252	5,650	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
69	Alpha	ndpm/100 cm ²	19	7	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	484	50	Note 1
Transformer	Gamma	contact cpm	6,574	5,648	4,780
	Gamma	1-meter cpm	7,642	6,129	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
70	Alpha	ndpm/100 cm ²	100	30	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	504	Note 2	Note 1
Transformer	Gamma	contact cpm	5,429	4,524	4,780
	Gamma	1-meter cpm	5,837	4,734	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
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Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
71	Alpha	ndpm/100 cm ²	43	29	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	538	90	Note 1
Electrical Panel	Gamma	contact cpm	5,424	4,998	4,780
	Gamma	1-meter cpm	5,902	5,648	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
72	Alpha	ndpm/100 cm ²	171	57	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	4,731	759	Note 1
Tank	Gamma	contact cpm	4,731	4,326	4,780
	Gamma	1-meter cpm	4,726	4,260	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
73	Alpha	ndpm/100 cm ²	238	97	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	2,796	358	Note 1
Tank	Gamma	contact cpm	3,885	3,407	4,780
	Gamma	1-meter cpm	4,291	3,747	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
74	Alpha	ndpm/100 cm ²	76	62	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	1,613	1,434	Note 1
Water Heater	Gamma	contact cpm	4,066	3,766	4,780
	Gamma	1-meter cpm	4,596	4,393	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
75	Alpha	ndpm/100 cm ²	195	112	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	914	251	Note 1
Electrical Panel	Gamma	contact cpm	4,221	4,198	4,780
	Gamma	1-meter cpm	4,371	4,281	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
76	Alpha	ndpm/100 cm ²	90	57	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	1,989	408	Note 1
Dust Control	Gamma	contact cpm	6,069	5,459	4,780
	Gamma	1-meter cpm	6,513	5,405	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				
77	Alpha	ndpm/100 cm ²	52	25	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Blower	Gamma	contact cpm	4,205	3,849	4,780
	Gamma	1-meter cpm	4,456	4,329	4,780
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.2 Chemical "A" Building (Building No. 16)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
78	Alpha	ndpm/100 cm ²	38	29	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Heater	Gamma	contact cpm	3,471	3,412	4,686
	Gamma	1-meter cpm	3,730	3,552	4,686
Contamination Mode	Surface (penetration is unlikely but unknown)				
79	Alpha	ndpm/100 cm ²	38	20	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Heater	Gamma	contact cpm	3,401	3,391	4,686
	Gamma	1-meter cpm	3,730	3,615	4,686
Contamination Mode	Surface (penetration is unlikely but unknown)				
80	Alpha	ndpm/100 cm ²	248	119	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	13,065	2,204	Note 1
Heater Unit	Gamma	contact cpm	19,605	7,290	4,686
	Gamma	1-meter cpm	8,190	5,351	4,686
Contamination Mode	Surface (penetration is unlikely but unknown)				
81	Alpha	ndpm/100 cm ²	138	23	Note 1
Room 106	Beta/Gamma	ndpm/100 cm ²	3,011	272	Note 1
	Gamma	contact cpm	12,668	9,023	6,952
	Gamma	1-meter cpm	11,659	8,747	6,952
Contamination Mode	Surface (penetration is unlikely but unknown)				
82	Alpha	ndpm/100 cm ²	206	56	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	30,970	1,540	Note 1
Exterior	Gamma	contact cpm	35,926	13,556	6,977
	Gamma	1-meter cpm	52,262	14,641	6,977
Contamination Mode	Surface (penetration is unlikely but unknown)				
83	Alpha	ndpm/100 cm ²	1,924	141	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	29,282	1,309	Note 1
	Gamma	contact cpm	56,118	9,010	7,961
	Gamma	1-meter cpm	24,165	8,367	7,961
Contamination Mode	Surface (penetration is unlikely but unknown)				
84	Alpha	ndpm/100 cm ²	544	78	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	2,250	535	Note 1
	Gamma	contact cpm	9,733	6,279	6,917
	Gamma	1-meter cpm	11,848	5,830	6,917
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
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Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
85	Alpha	ndpm/100 cm ²	277	107	Note 1
Room 103	Beta/Gamma	ndpm/100 cm ²	6,276	1,984	Note 1
	Gamma	contact cpm	24,166	13,278	7,698
	Gamma	1-meter cpm	19,140	12,654	7,698
	Contamination Mode Surface (penetration is unlikely but unknown)				
86	Alpha	ndpm/100 cm ²	1,005	192	Note 1
Room 104	Beta/Gamma	ndpm/100 cm ²	31,290	3,250	Note 1
	Gamma	contact cpm	34,437	19,933	7,372
	Gamma	1-meter cpm	26,079	19,120	7,372
	Contamination Mode Surface (penetration is unlikely but unknown)				
87	Alpha	ndpm/100 cm ²	90	34	Note 1
Room 105	Beta/Gamma	ndpm/100 cm ²	2,581	550	Note 1
	Gamma	contact cpm	13,877	11,850	4,724
	Gamma	1-meter cpm	13,185	11,749	4,724
	Contamination Mode Surface (penetration is unlikely but unknown)				
88	Alpha	ndpm/100 cm ²	214	59	Note 1
Room 107	Beta/Gamma	ndpm/100 cm ²	1,565	349	Note 1
	Gamma	contact cpm	6,810	5,994	6,540
	Gamma	1-meter cpm	7,153	5,727	6,540
	Contamination Mode Surface (penetration is unlikely but unknown)				
89	Alpha	ndpm/100 cm ²	29	7	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	227	18	Note 1
	Gamma	contact cpm	13,486	11,855	8,994
	Gamma	1-meter cpm	14,475	12,009	8,994
	Contamination Mode Surface (penetration is unlikely but unknown)				
90	Alpha	ndpm/100 cm ²	15	2	Note 1
Room 109	Beta/Gamma	ndpm/100 cm ²	2,522	289	Note 1
	Gamma	contact cpm	11,633	9,782	7,692
	Gamma	1-meter cpm	13,133	10,036	7,692
	Contamination Mode Surface (penetration is unlikely but unknown)				
91	Alpha	ndpm/100 cm ²	905	231	Note 1
Room 110	Beta/Gamma	ndpm/100 cm ²	3,117	633	Note 1
	Gamma	contact cpm	12,948	2,874	4,912
	Gamma	1-meter cpm	14,265	2,878	4,912
	Contamination Mode Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
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Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
92	Alpha	ndpm/100 cm ²	538	72	Note 1
Room 111	Beta/Gamma	ndpm/100 cm ²	2,042	671	Note 1
	Gamma	contact cpm	15,486	12,546	9,264
	Gamma	1-meter cpm	15,488	12,613	9,264
Contamination Mode	Surface (penetration is unlikely but unknown)				
93	Alpha	ndpm/100 cm ²	310	35	Note 1
Room 112	Beta/Gamma	ndpm/100 cm ²	7,200	922	Note 1
	Gamma	contact cpm	12,141	8,779	6,356
	Gamma	1-meter cpm	13,319	8,712	6,356
Contamination Mode	Surface (penetration is unlikely but unknown)				
94	Alpha	ndpm/100 cm ²	138	25	Note 1
Room 113	Beta/Gamma	ndpm/100 cm ²	3,548	1,121	Note 1
	Gamma	contact cpm	13,488	11,025	8,852
	Gamma	1-meter cpm	12,177	10,618	8,852
Contamination Mode	Surface (penetration is unlikely but unknown)				
95	Alpha	ndpm/100 cm ²	81	13	Note 1
Room 301	Beta/Gamma	ndpm/100 cm ²	1,667	101	Note 1
	Gamma	contact cpm	7,776	5,899	4,570
	Gamma	1-meter cpm	7,473	5,780	4,570
Contamination Mode	Surface (penetration is unlikely but unknown)				
96	Alpha	ndpm/100 cm ²	435	54	Note 1
Room 302	Beta/Gamma	ndpm/100 cm ²	1,887	335	Note 1
	Gamma	contact cpm	9,026	7,371	8,005
	Gamma	1-meter cpm	9,079	7,375	8,005
Contamination Mode	Surface (penetration is unlikely but unknown)				
97	Alpha	ndpm/100 cm ²	65	24	Note 1
Room 303	Beta/Gamma	ndpm/100 cm ²	582	234	Note 1
	Gamma	contact cpm	9,665	7,899	8,293
	Gamma	1-meter cpm	9,457	7,781	8,293
Contamination Mode	Surface (penetration is unlikely but unknown)				
98	Alpha	ndpm/100 cm ²	124	35	Note 1
Room 304	Beta/Gamma	ndpm/100 cm ²	1,882	108	Note 1
	Gamma	contact cpm	5,478	4,128	4,500
	Gamma	1-meter cpm	5,870	4,113	4,500
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
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Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
99	Alpha	ndpm/100 cm ²	141	42	Note 1
Room 305	Beta/Gamma	ndpm/100 cm ²	1,036	457	Note 1
	Gamma	contact cpm	9,365	7,836	8,293
	Gamma	1-meter cpm	9,759	7,888	8,293
Contamination Mode	Surface (penetration is unlikely but unknown)				
100	Alpha	ndpm/100 cm ²	100	44	Note 1
Room 306	Beta/Gamma	ndpm/100 cm ²	1,057	332	Note 1
	Gamma	contact cpm	8,451	6,901	8,722
	Gamma	1-meter cpm	8,169	7,007	8,722
Contamination Mode	Surface (penetration is unlikely but unknown)				
101	Alpha	ndpm/100 cm ²	125	20	Note 1
Room 307	Beta/Gamma	ndpm/100 cm ²	1,350	113	Note 1
	Gamma	contact cpm	6,741	5,816	8,390
	Gamma	1-meter cpm	6,946	5,795	8,390
Contamination Mode	Surface (penetration is unlikely but unknown)				
102	Alpha	ndpm/100 cm ²	67	17	Note 1
Room 308	Beta/Gamma	ndpm/100 cm ²	699	44	Note 1
	Gamma	contact cpm	3,894	3,116	3,790
	Gamma	1-meter cpm	3,915	3,107	3,790
Contamination Mode	Surface (penetration is unlikely but unknown)				
103	Alpha	ndpm/100 cm ²	94	20	Note 1
Room 309	Beta/Gamma	ndpm/100 cm ²	1,622	240	Note 1
	Gamma	contact cpm	9,482	6,548	8,767
	Gamma	1-meter cpm	8,643	6,164	8,767
Contamination Mode	Surface (penetration is unlikely but unknown)				
104	Alpha	ndpm/100 cm ²	57	10	Note 1
Room 310	Beta/Gamma	ndpm/100 cm ²	645	47	Note 1
	Gamma	contact cpm	2,938	2,418	2,766
	Gamma	1-meter cpm	2,667	2,329	2,766
Contamination Mode	Surface (penetration is unlikely but unknown)				
105	Alpha	ndpm/100 cm ²	210	32	Note 1
Room 311	Beta/Gamma	ndpm/100 cm ²	30,860	1,238	Note 1
	Gamma	contact cpm	17,538	7,049	7,644
	Gamma	1-meter cpm	92,238	7,883	7,644
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16)
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Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
106	Alpha	ndpm/100 cm ²	62	12	Note 1
Room 312	Beta/Gamma	ndpm/100 cm ²	1,935	125	Note 1
	Gamma	contact cpm	4,063	2,914	2,552
	Gamma	1-meter cpm	3,008	2,762	2,552
Contamination Mode	Surface (penetration is unlikely but unknown)				
107	Alpha	ndpm/100 cm ²	81	18	Note 1
Room 313	Beta/Gamma	ndpm/100 cm ²	2,312	724	Note 1
	Gamma	contact cpm	5,773	3,824	2,619
	Gamma	1-meter cpm	5,066	3,865	2,619
Contamination Mode	Surface (penetration is unlikely but unknown)				
108	Alpha	ndpm/100 cm ²	50	12	Note 1
Room 314	Beta/Gamma	ndpm/100 cm ²	332	33	Note 1
	Gamma	contact cpm	9,922	6,646	8,522
	Gamma	1-meter cpm	10,017	6,778	8,522
Contamination Mode	Surface (penetration is unlikely but unknown)				
109	Alpha	ndpm/100 cm ²	60	7	Note 1
Room 315	Beta/Gamma	ndpm/100 cm ²	59	1	Note 1
	Gamma	contact cpm	15,955	9,762	8,508
	Gamma	1-meter cpm	13,406	10,763	8,508
Contamination Mode	Surface (penetration is unlikely but unknown)				
110	Alpha	ndpm/100 cm ²	244	58	Note 1
Room 401	Beta/Gamma	ndpm/100 cm ²	10,645	1,159	Note 1
	Gamma	contact cpm	13,837	7,036	6,159
	Gamma	1-meter cpm	47,451	6,831	6,159
Contamination Mode	Surface (penetration is unlikely but unknown)				
111	Alpha	ndpm/100 cm ²	271	66	Note 1
Room 402	Beta/Gamma	ndpm/100 cm ²	5,538	945	Note 1
	Gamma	contact cpm	7,271	5,171	4,806
	Gamma	1-meter cpm	7,368	5,319	4,806
Contamination Mode	Surface (penetration is unlikely but unknown)				
112	Alpha	ndpm/100 cm ²	100	46	Note 1
Elevator	Beta/Gamma	ndpm/100 cm ²	2,343	923	Note 1
	Gamma	contact cpm	17,046	14,169	8,432
	Gamma	1-meter cpm	17,968	14,584	8,432
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.2 Chemical "A" Building (Building No. 16) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
113 Elevator Shaft	Alpha	ndpm/100 cm ²	1,188	220	Note 1
	Beta/Gamma	ndpm/100 cm ²	11,238	2,946	Note 1
	Gamma	contact cpm	19,844	15,999	8,440
	Gamma	1-meter cpm	19,980	15,598	8,440
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. Contains ten rooms on three levels containing tanks, vessels, boiler room, air compressor, laboratories, offices, and records storage. Former operations in this building included EB melting of uranium, chemical purification of tantalum, and storage of feed material. Building is constructed of concrete brick walls with 10-inch gap to outside brick wall, concrete floor, and roof.				
Characterization Map	Figures 4-3A, 4-3B, 4-3C, 4-3D				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<p>3. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm².</p> <p>4. Measurement results were indistinguishable above background.</p>				

4.2.3 Thermite Building (Building No. 9)

4.2.3 Thermite Building (Building No. 9) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1 Exterior	Alpha	ndpm/100 cm ²	50	50	Note 1
Roof Vent	Beta/Gamma	ndpm/100 cm ²	743	543	Note 1
	Gamma	contact cpm	7,025	7,025	7,837
	Gamma	1-meter cpm	8,401	8,401	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
2 Exterior	Alpha	ndpm/100 cm ²	94	42	Note 1
Lime Silo	Beta/Gamma	ndpm/100 cm ²	157	30	Note 1
	Gamma	contact cpm	6,721	5,534	6,107
	Gamma	1-meter cpm	5,187	4,942	6,107
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.3 Thermite Building (Building No. 9) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
3	Alpha	ndpm/100 cm ²	39	39	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Pipe Threader	Gamma	contact cpm	3,168	3,168	3,581
	Gamma	1-meter cpm	3,441	3,441	3,581
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	72	47	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	1,210	202	Note 1
Weir	Gamma	contact cpm	3,179	3,058	3,581
	Gamma	1-meter cpm	2,937	2,922	3,581
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	129	77	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	287	75	Note 1
Overhead Crane	Gamma	contact cpm	5,090	4,332	7,733
	Gamma	1-meter cpm	6,887	6,226	7,733
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	121	45	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	983	232	Note 1
Exterior	Gamma	contact cpm	12,521	6,898	6,593
	Gamma	1-meter cpm	13,388	7,465	6,593
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	144	30	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	429	37	Note 1
	Gamma	contact cpm	13,144	6,398	5,846
	Gamma	1-meter cpm	9,948	5,881	5,846
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. Contains a single room that formerly housed a furnace for heating material and was used to discharge water. The building contains a tool crib and open space, a small overhead crane, two roll-up doors, and two man-doors. The structure is fabricated with corrugated metal walls with a concrete floor.				
Characterization Map	Figure 4-4				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.2.4 Sodium Reduction Building (Building No. 11)

4.2.4 Sodium Reduction Building (Building No. 11)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	350	188	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	735	229	Note 1
Vent	Gamma	contact cpm	8,086	7,177	7,837
	Gamma	1-meter cpm	10,425	8,724	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	86	33	Note 1
Exterior Roof	Beta/Gamma	ndpm/100 cm ²	1,865	307	Note 1
Vent	Gamma	contact cpm	7,222	6,865	7,837
	Gamma	1-meter cpm	8,350	8,171	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	157	64	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,609	365	Note 1
Roof Vent	Gamma	contact cpm	8,216	7,527	7,837
	Gamma	1-meter cpm	9,852	8,806	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	29	29	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	948	667	Note 1
Roof Vent	Gamma	contact cpm	9,367	9,367	7,837
	Gamma	1-meter cpm	13,007	13,007	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	270	141	Note 1
Small Sump	Gamma	contact cpm	6,099	5,984	6,013
	Gamma	1-meter cpm	5,764	5,659	6,013
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	6	3	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	125	49	Note 1
Sump No. 2	Gamma	contact cpm	6,075	5,897	6,013
	Gamma	1-meter cpm	6,245	5,922	6,013
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	33	20	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,878	308	Note 1
Large Sump	Gamma	contact cpm	7,069	6,291	8,722
	Gamma	1-meter cpm	7,086	6,713	8,722
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.4 Sodium Reduction Building (Building No. 11)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
8	Alpha	ndpm/100 cm ²	19	13	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	744	103	Note 1
Sump	Gamma	contact cpm	8,504	7,997	8,487
	Gamma	1-meter cpm	8,445	8,134	8,487
Contamination Mode	Surface (penetration is unlikely but unknown)				
9	Alpha	ndpm/100 cm ²	30	12	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	180	26	Note 1
Sump	Gamma	contact cpm	6,121	5,603	5,804
	Gamma	1-meter cpm	4,926	4,660	5,804
Contamination Mode	Surface (penetration is unlikely but unknown)				
10	Alpha	ndpm/100 cm ²	707	78	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	2,100	272	Note 1
Exterior	Gamma	contact cpm	16,437	6,250	6,337
	Gamma	1-meter cpm	16,197	7,065	6,337
Contamination Mode	Surface (penetration is unlikely but unknown)				
11	Alpha	ndpm/100 cm ²	78	22	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	1,250	196	Note 1
	Gamma	contact cpm	6,888	4,402	4,691
	Gamma	1-meter cpm	11,360	4,297	4,691
Contamination Mode	Surface (penetration is unlikely but unknown)				
12	Alpha	ndpm/100 cm ²	46	12	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	1,935	449	Note 1
	Gamma	contact cpm	3,588	3,045	4,418
	Gamma	1-meter cpm	3,141	2,934	4,418
Contamination Mode	Surface (penetration is unlikely but unknown)				
13	Alpha	ndpm/100 cm ²	14	3	Note 1
Room 103	Beta/Gamma	ndpm/100 cm ²	652	128	Note 1
	Gamma	contact cpm	8,201	6,197	7,842
	Gamma	1-meter cpm	8,355	6,487	7,842
Contamination Mode	Surface (penetration is unlikely but unknown)				
14	Alpha	ndpm/100 cm ²	To be determined	To be determined	To be determined
Remaining Foundation	Beta/Gamma	ndpm/100 cm ²			
	Gamma	contact cpm			
	Gamma	1-meter cpm			
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.4 Sodium Reduction Building (Building No. 11) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
Structure/Room Descriptions	Impacted. The Sodium Reduction Building was removed leaving only the concrete foundation intact. Catalog Entries 1 through 13 are included for information only. The Sodium Reduction Building was formerly used to reduce tantalum powder using metallic sodium. There were approximately 1,200 bags of Pond No. 5 residues stacked within the building and miscellaneous storage of WIP and CaF materials. The structure contained three rooms with corrugated metal walls and a concrete floor.				
Characterization Map	Figure 4-7				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.2.5 R&D Laboratory Building (Building No. 15)

4.2.5 R&D Laboratory Building (Building No. 15) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	60	60	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	210	173	Note 1
Roof Vent	Gamma	contact cpm	9,404	9,404	6,629
	Gamma	1-meter cpm	10,538	10,538	6,629
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	153	153	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	371	124	Note 1
Roof Vent	Gamma	contact cpm	8,749	8,749	6,629
	Gamma	1-meter cpm	8,780	8,780	6,629
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	200	200	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	186	160	Note 1
Roof Vent	Gamma	contact cpm	7,534	7,534	6,629
	Gamma	1-meter cpm	8,404	8,404	6,629
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
4	Alpha	ndpm/100 cm ²	473	473	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	552	413	Note 1
Roof Vent	Gamma	contact cpm	8,450	8,450	6,629
	Gamma	1-meter cpm	9,162	9,162	6,629
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	367	367	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	533	381	Note 1
Roof Vent	Gamma	contact cpm	8,069	8,069	6,629
	Gamma	1-meter cpm	8,147	8,147	6,629
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	33	30	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	548	294	Note 1
Drill Press	Gamma	contact cpm	7,017	6,464	6,359
	Gamma	1-meter cpm	6,766	6,680	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	13	13	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	1,119	874	Note 1
Washer	Gamma	contact cpm	6,935	6,935	6,359
	Gamma	1-meter cpm	7,567	7,567	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
8	Alpha	ndpm/100 cm ²	20	20	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Storage Room	Gamma	contact cpm	5,603	5,603	6,359
	Gamma	1-meter cpm	5,649	5,649	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
9	Alpha	ndpm/100 cm ²	27	27	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Furnace	Gamma	contact cpm	7,193	7,193	6,359
	Gamma	1-meter cpm	6,766	6,766	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
10	Alpha	ndpm/100 cm ²	33	13	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Furnace	Gamma	contact cpm	6,776	6,776	6,359
	Gamma	1-meter cpm	6,950	6,950	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
11	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Pump	Gamma	contact cpm	3,769	3,769	6,359
	Gamma	1-meter cpm	5,992	5,992	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
12	Alpha	ndpm/100 cm ²	7	7	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Heater	Gamma	contact cpm	6,656	6,656	6,359
	Gamma	1-meter cpm	8,523	8,523	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
13	Alpha	ndpm/100 cm ²	167	167	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Welding	Gamma	contact cpm	6,998	6,998	6,359
Machine	Gamma	1-meter cpm	7,800	7,800	6,359
Contamination Mode	Surface (penetration is unlikely but unknown)				
14	Alpha	ndpm/100 cm ²	18	4	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	248	90	Note 1
Hood	Gamma	contact cpm	6,461	6,297	5,937
	Gamma	1-meter cpm	6,920	6,604	5,937
Contamination Mode	Surface (penetration is unlikely but unknown)				
15	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	167	71	Note 1
Hood	Gamma	contact cpm	6,231	6,128	5,937
	Gamma	1-meter cpm	6,408	6,237	5,937
Contamination Mode	Surface (penetration is unlikely but unknown)				
16	Alpha	ndpm/100 cm ²	35	7	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	433	121	Note 1
Hood	Gamma	contact cpm	11,630	8,231	5,937
	Gamma	1-meter cpm	11,804	7,381	5,937
Contamination Mode	Surface (penetration is unlikely but unknown)				
17	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 102	Beta/Gamma	ndpm/100 cm ²	76	17	Note 1
Hood	Gamma	contact cpm	6,676	6,358	5,937
	Gamma	1-meter cpm	6,871	6,311	5,937
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
18	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 103	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Fountain	Gamma	contact cpm	5,018	5,018	6,749
	Gamma	1-meter cpm	6,241	6,241	6,749
Contamination Mode	Surface (penetration is unlikely but unknown)				
19	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 104	Beta/Gamma	ndpm/100 cm ²	33	10	Note 1
Urinal Stall	Gamma	contact cpm	6,934	6,630	6,749
	Gamma	1-meter cpm	14,504	11,220	6,749
Contamination Mode	Surface (penetration is unlikely but unknown)				
20	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 104	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Urinal Stall	Gamma	contact cpm	6,105	6,013	6,749
	Gamma	1-meter cpm	6,010	5,847	6,749
Contamination Mode	Surface (penetration is unlikely but unknown)				
21	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 104	Beta/Gamma	ndpm/100 cm ²	1,324	1,227	Note 1
Sink	Gamma	contact cpm	6,774	6,774	7,083
	Gamma	1-meter cpm	6,630	6,630	7,083
Contamination Mode	Surface (penetration is unlikely but unknown)				
22	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 104	Beta/Gamma	ndpm/100 cm ²	1,333	1,333	Note 1
Sink	Gamma	contact cpm	7,202	7,202	7,083
	Gamma	1-meter cpm	6,954	6,954	7,083
Contamination Mode	Surface (penetration is unlikely but unknown)				
23	Alpha	ndpm/100 cm ²	24	18	Note 1
Room 105	Beta/Gamma	ndpm/100 cm ²	124	90.5	Note 1
Sink	Gamma	contact cpm	3,942	3,826	7,308
	Gamma	1-meter cpm	4,555	4,530	7,308
Contamination Mode	Surface (penetration is unlikely but unknown)				
24	Alpha	ndpm/100 cm ²	35	18	Note 1
Room 106	Beta/Gamma	ndpm/100 cm ²	1,676	788	Note 1
Sink	Gamma	contact cpm	6,558	6,049	7,308
	Gamma	1-meter cpm	5,647	5,613	7,308
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
25	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Conditioner	Gamma	contact cpm	6,276	5,462	7,110
	Gamma	1-meter cpm	7,296	6,620	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				
25	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Duct	Gamma	contact cpm	5,314	5,241	7,110
	Gamma	1-meter cpm	5,680	5,629	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				
26	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Duct	Gamma	contact cpm	5,262	5,171	7,110
	Gamma	1-meter cpm	5,572	5,526	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				
27	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Conditioner	Gamma	contact cpm	6,060	5,476	7,110
	Gamma	1-meter cpm	6,022	5,934	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				
28	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Lockers	Gamma	contact cpm	5,837	5,530	7,110
	Gamma	1-meter cpm	5,719	5,391	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				
29	Alpha	ndpm/100 cm ²	11	3	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Water Heater	Gamma	contact cpm	6,098	6,075	6,727
	Gamma	1-meter cpm	6,783	6,615	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				
30	Alpha	ndpm/100 cm ²	11	9	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Conditioner	Gamma	contact cpm	5,266	4,983	6,727
	Gamma	1-meter cpm	5,717	5,402	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
31	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Duct	Gamma	contact cpm	5,080	5,064	6,727
	Gamma	1-meter cpm	5,159	5,065	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				
32	Alpha	ndpm/100 cm ²	6	3	Note 1
Room 109	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Shower	Gamma	contact cpm	5,593	5,546	6,727
	Gamma	1-meter cpm	5,569	5,565	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				
33	Alpha	ndpm/100 cm ²	67	45	Note 1
Room 109	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Lockers	Gamma	contact cpm	5,642	5,637	6,727
	Gamma	1-meter cpm	5,790	5,497	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				
34	Alpha	ndpm/100 cm ²	44	22	Note 1
Room 109	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Air Vent	Gamma	contact cpm	5,189	4,973	6,710
	Gamma	1-meter cpm	5,551	5,175	6,710
Contamination Mode	Surface (penetration is unlikely but unknown)				
35	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 205	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Sink	Gamma	contact cpm	3,440	3,440	6,672
	Gamma	1-meter cpm	4,769	4,769	6,672
Contamination Mode	Surface (penetration is unlikely but unknown)				
36	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 207	Beta/Gamma	ndpm/100 cm ²	573	394	Note 1
Water Fountain	Gamma	contact cpm	5,180	5,180	5,670
	Gamma	1-meter cpm	5,369	5,369	5,670
Contamination Mode	Surface (penetration is unlikely but unknown)				
37	Alpha	ndpm/100 cm ²	2,133	276	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	1,667	745	Note 1
Exterior	Gamma	contact cpm	13,909	9,546	7,496
	Gamma	1-meter cpm	14,398	9,903	7,496
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
38 Room 101	Alpha	ndpm/100 cm ²	311	13	Note 1
	Beta/Gamma	ndpm/100 cm ²	6,538	167	Note 1
	Gamma	contact cpm	13,551	7,667	6,327
	Gamma	1-meter cpm	10,487	7,066	6,327
Contamination Mode	Surface (penetration is unlikely but unknown)				
39 Room 102	Alpha	ndpm/100 cm ²	41	8	Note 1
	Beta/Gamma	ndpm/100 cm ²	319	21	Note 1
	Gamma	contact cpm	9,192	6,570	6,210
	Gamma	1-meter cpm	11,905	6,871	6,210
Contamination Mode	Surface (penetration is unlikely but unknown)				
40 Room 103	Alpha	ndpm/100 cm ²	29	8	Note 1
	Beta/Gamma	ndpm/100 cm ²	1,210	113	Note 1
	Gamma	contact cpm	10,686	7,427	7,416
	Gamma	1-meter cpm	11,527	7,431	7,416
Contamination Mode	Surface (penetration is unlikely but unknown)				
41 Room 104	Alpha	ndpm/100 cm ²	6	1	Note 1
	Beta/Gamma	ndpm/100 cm ²	10	Note 2	Note 1
	Gamma	contact cpm	6,742	6,050	7,209
	Gamma	1-meter cpm	7,985	6,314	7,209
Contamination Mode	Surface (penetration is unlikely but unknown)				
42 Room 105	Alpha	ndpm/100 cm ²	6	2	Note 1
	Beta/Gamma	ndpm/100 cm ²	57	4	Note 1
	Gamma	contact cpm	6,027	5,671	7,308
	Gamma	1-meter cpm	6,146	5,760	7,308
Contamination Mode	Surface (penetration is unlikely but unknown)				
43 Room 106	Alpha	ndpm/100 cm ²	6	Note 2	Note 1
	Beta/Gamma	ndpm/100 cm ²	76	8	Note 1
	Gamma	contact cpm	9,236	6,028	7,209
	Gamma	1-meter cpm	6,752	5,823	7,209
Contamination Mode	Surface (penetration is unlikely but unknown)				
44 Room 107	Alpha	ndpm/100 cm ²	6	2	Note 1
	Beta/Gamma	ndpm/100 cm ²	1,133	420	Note 1
	Gamma	contact cpm	10,814	9,468	7,110
	Gamma	1-meter cpm	9,783	9,646	7,110
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
45	Alpha	ndpm/100 cm ²	50	19	Note 1
Room 108	Beta/Gamma	ndpm/100 cm ²	810	122	Note 1
	Gamma	contact cpm	6,463	5,963	6,727
	Gamma	1-meter cpm	6,207	5,790	6,727
Contamination Mode	Surface (penetration is unlikely but unknown)				
46	Alpha	ndpm/100 cm ²	50	5	Note 1
Room 109	Beta/Gamma	ndpm/100 cm ²	748	128	Note 1
	Gamma	contact cpm	8,558	6,456	6,719
	Gamma	1-meter cpm	8,439	6,596	6,719
Contamination Mode	Surface (penetration is unlikely but unknown)				
47	Alpha	ndpm/100 cm ²	33	7	Note 1
Room 110	Beta/Gamma	ndpm/100 cm ²	1,119	208	Note 1
	Gamma	contact cpm	11,763	8,292	6,889
	Gamma	1-meter cpm	9,701	7,655	6,889
Contamination Mode	Surface (penetration is unlikely but unknown)				
48	Alpha	ndpm/100 cm ²	16	2	Note 1
Room 201	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
	Gamma	contact cpm	8,752	6,958	6,302
	Gamma	1-meter cpm	8,431	6,917	6,302
Contamination Mode	Surface (penetration is unlikely but unknown)				
49	Alpha	ndpm/100 cm ²	22	2	Note 1
Room 202	Beta/Gamma	ndpm/100 cm ²	167	23	Note 1
	Gamma	contact cpm	9,037	7,223	6,800
	Gamma	1-meter cpm	8,824	7,300	6,800
Contamination Mode	Surface (penetration is unlikely but unknown)				
50	Alpha	ndpm/100 cm ²	11	2	Note 1
Room 203	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
	Gamma	contact cpm	5,816	5,605	6,889
	Gamma	1-meter cpm	6,039	5,651	6,889
Contamination Mode	Surface (penetration is unlikely but unknown)				
51	Alpha	ndpm/100 cm ²	11	1	Note 1
Room 204	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
	Gamma	contact cpm	6,028	5,478	6,347
	Gamma	1-meter cpm	5,777	5,491	6,347
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.5 R&D Laboratory Building (Building No. 15) Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
52	Alpha	ndpm/100 cm ²	40	9	Note 1
Room 205	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
	Gamma	contact cpm	6,249	5,398	6,672
	Gamma	1-meter cpm	6,354	5,575	6,672
Contamination Mode	Surface (penetration is unlikely but unknown)				
53	Alpha	ndpm/100 cm ²	16	3	Note 1
Room 206	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
	Gamma	contact cpm	6,457	5,804	6,302
	Gamma	1-meter cpm	6,368	5,867	6,302
Contamination Mode	Surface (penetration is unlikely but unknown)				
54	Alpha	ndpm/100 cm ²	33	5	Note 1
Room 207	Beta/Gamma	ndpm/100 cm ²	1,864	92	Note 1
	Gamma	contact cpm	8,633	6,134	6,025
	Gamma	1-meter cpm	12,760	6,239	6,025
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. The R&D Laboratory Building has multiple rooms containing office, laboratory, and warehouse space and was formerly used to conduct research and development. The structure is corrugated metal.				
Characterization Map	Figure 4-6				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.2.6 Groundwater Treatment Facility

4.2.6 Groundwater Treatment Facility Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	14	14	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,865	787	Note 1
Roof Vent	Gamma	contact cpm	7,222	7,222	7,804
	Gamma	1-meter cpm	8,350	8,350	7,804

4.2.6 Groundwater Treatment Facility Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	14	14	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,609	771	Note 1
Roof Vent	Gamma	contact cpm	8,216	8,216	7,804
	Gamma	1-meter cpm	8,745	8,745	7,804
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	29	29	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	83	28	Note 1
Drill Press	Gamma	contact cpm	6,296	6,296	7,829
	Gamma	1-meter cpm	7,276	7,276	7,829
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	7	7	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Heater	Gamma	contact cpm	10,122	10,122	7,829
	Gamma	1-meter cpm	11,717	11,717	7,829
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	21	21	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Drill Press Table	Gamma	contact cpm	5,512	5,512	7,829
	Gamma	1-meter cpm	7,251	7,251	7,829
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. The Groundwater Treatment Facility has two rooms and was formerly used to process potentially contaminated groundwater by evaporation of clean water resulting in high-concentration slurry. The structure is fabricated with corrugated metal walls with a concrete floor and sits over the former Gunch House.				
Characterization Map	Figure 4-4				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.2.7 Bertha Building (Building No. 12)

4.2.7 Bertha Building (Building No. 12)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	179	179	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	861	809	Note 1
Roof Vent	Gamma	contact cpm	16,636	16,636	7,837
	Gamma	1-meter cpm	17,397	17,397	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	229	229	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	865	739	Note 1
Roof Vent	Gamma	contact cpm	14,525	14,525	7,837
	Gamma	1-meter cpm	13,449	13,449	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	293	293	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	883	836	Note 1
Roof Vent	Gamma	contact cpm	16,438	16,438	7,837
	Gamma	1-meter cpm	14,033	14,033	7,837
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	557	142	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	2,165	647	Note 1
Exterior	Gamma	contact cpm	15,248	13,299	7,840
	Gamma	1-meter cpm	17,763	14,708	7,840
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	2,136	396	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	11,826	2,583	Note 1
	Gamma	contact cpm	15,766	13,372	7,830
	Gamma	1-meter cpm	14,276	12,502	7,830
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Impacted. The Bertha Building was built in 1999 and has one room and was formerly used as a mini-laboratory for pilot projects. The building is constructed of wood with corrugated metal.				
Characterization Map	Figure 4-7				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm ² . 2. Measurement results were indistinguishable above background.				

4.2.8 Weir Building (Building No. 10)

4.2.8 Weir Building (Building No. 10)
Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	200	200	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	583	228	Note 1
Roof Vent	Gamma	contact cpm	8,086	8,086	7,804
	Gamma	1-meter cpm	7,927	7,927	7,804
Contamination Mode	Surface (penetration is unlikely but unknown)				
2	Alpha	ndpm/100 cm ²	14	14	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,865	787	Note 1
Roof Vent	Gamma	contact cpm	7,222	7,222	7,804
	Gamma	1-meter cpm	8,350	8,350	7,804
Contamination Mode	Surface (penetration is unlikely but unknown)				
3	Alpha	ndpm/100 cm ²	14	14	Note 1
Exterior	Beta/Gamma	ndpm/100 cm ²	1,609	771	Note 1
Roof Vent	Gamma	contact cpm	8,216	8,216	7,804
	Gamma	1-meter cpm	8,745	8,745	7,804
Contamination Mode	Surface (penetration is unlikely but unknown)				
4	Alpha	ndpm/100 cm ²	Note 2	Note 2	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	220	5,182	Note 1
Heater	Gamma	contact cpm	8,858	8,855	6,231
	Gamma	1-meter cpm	8,496	8,496	6,231
Contamination Mode	Surface (penetration is unlikely but unknown)				
5	Alpha	ndpm/100 cm ²	11	6	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	Note 2	Note 2	Note 1
Pump	Gamma	contact cpm	5,762	5,689	5,845
	Gamma	1-meter cpm	5,666	5,619	5,845
Contamination Mode	Surface (penetration is unlikely but unknown)				
6	Alpha	ndpm/100 cm ²	67	42	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	205	177	Note 1
Pump	Gamma	contact cpm	14,348	13,507	6,231
	Gamma	1-meter cpm	15,938	15,328	6,231
Contamination Mode	Surface (penetration is unlikely but unknown)				
7	Alpha	ndpm/100 cm ²	11	9	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	90	48	Note 1
Weir	Gamma	contact cpm	8,004	8,004	6,231
	Gamma	1-meter cpm	7,859	7,859	6,231
Contamination Mode	Surface (penetration is unlikely but unknown)				

**4.2.8 Weir Building (Building No. 10)
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
8	Alpha	ndpm/100 cm ²	229	73	Note 1
Building	Beta/Gamma	ndpm/100 cm ²	1,074	319	Note 1
Exterior	Gamma	contact cpm	15,352	7,626	5,709
	Gamma	1-meter cpm	16,483	8,412	5,709
Contamination Mode	Surface (penetration is unlikely but unknown)				
9	Alpha	ndpm/100 cm ²	39	17	Note 1
Room 101	Beta/Gamma	ndpm/100 cm ²	240	56	Note 1
	Gamma	contact cpm	11,101	9,142	6,038
	Gamma	1-meter cpm	10,190	8,761	6,038
Contamination Mode	Surface (penetration is unlikely but unknown)				
Structure/Room Descriptions	Nonimpacted. The Weir Building (Outfall 001 Building) has one room and was formerly used for wastewater discharge into the Arkansas River. The building is constructed of wood with corrugated metal and a concrete floor and features one sliding barn door and two man-doors.				
Characterization Map	Figure 4-5				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm ² . 2. Measurement results were indistinguishable above background.				

4.2.9 Ore Storage Pad

**4.2.9 Ore Storage Pad
Radiological Characterization Catalog**

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
1	Alpha	ndpm/100 cm ²	To be determined	To be determined	To be determined
Grid To be determined	Beta/Gamma	ndpm/100 cm ²			
	Gamma	contact cpm			
	Gamma	1-meter cpm			
Contamination Mode	Surface (penetration is unlikely but unknown)				

4.2.9 Ore Storage Pad Radiological Characterization Catalog

Survey Location	Radiation Surveyed	Survey Units	Maximum Measurement	Average Measurement	Background Measurement
Structure/Room Descriptions	Impacted. The ore storage pad is an open concrete-bermed pad and was formerly used as a chemical tank farm and Tallabor drum storage (some leakage). This pad was historically a gravel pad prior to 1980.				
Characterization Map	Figure 4-7				
Data Source	Earth Sciences Consultants, Inc., December 1993, <i>Remediation Assessment</i> , Fansteel Inc., Muskogee, Oklahoma.				
Notes	<ol style="list-style-type: none"> 1. The alpha and beta/gamma background values were recorded in gross cpm and subtracted from the gross cpm measured on contact with the structure surface; the net cpm value was then converted to dpm/100 cm². 2. Measurement results were indistinguishable above background. 				

4.3 Surface and Subsurface Soil Contamination

4.3.1 Soil Surface Instrument Surveys

The instrument surveys of open land soil surfaces were not conclusive. Measurements of alpha and beta/gamma contamination of soil surfaces are not useful due to the short ranges of these particles and the uneven porous surface of soil. Although gross gamma surveys are able to detect uranium and thorium radionuclides in soil, the results were compromised by the shine from the large quantities of radioactive materials in Pond Nos. 2 and 3, and to a lesser extent in Pond No. 5. Refer to Figures 4-8 and 4-9 for the results of the gamma surveys conducted at the surface and at 1 m.

4.3.2 Surface and Subsurface Soil Sample Analyses

A total of 96 borings (including 67 soil borings, 25 shallow monitoring wells, and 4 bedrock monitoring wells) were completed as part of the subsurface investigations conducted at the Fansteel facility. Soil borings were completed to characterize the soil conditions only and, therefore, were advanced to the top of the uppermost zone of saturation. Boreholes for shallow monitoring wells were advanced to the top of bedrock to characterize soil and shallow groundwater conditions. Boreholes for deep monitoring wells were advanced into bedrock to characterize groundwater conditions within the underlying shale. The locations of the 96 borings are presented in Figure 4-1.

Three samples were selected for laboratory analysis for radiological and/or chemical constituents from each of the borings, with the exception of the deep monitoring wells. For radiological analysis, samples

were secured from the depth interval of 0 to 6 inches, the interval immediately above the zone of saturation, and an intermediate interval displaying the highest beta/gamma reading. Soil samples were analyzed for gross alpha and beta by direct counting of 100 milligrams (mg) of soil using a gas-flow proportional counter. If either gross alpha or gross beta were detected at levels exceeding two times background, isotopic analyses were performed to determine the contributing species. Specific radionuclides were determined by gamma spectroscopy and radiochemical analysis.

Soil samples were also obtained from 12 test pits and 14 (out of the 96) soil borings in the central area (i.e., immediately west of the central processing area) which comprises the balance of the property. Radioactive contamination is essentially absent from the central plant area. Finally, background concentrations of uranium and thorium in soil were determined for soil representative of the site.

4.3.2.1 Soil Background Radioactivity

Background soil radioactivity concentrations of radionuclides of interest at the Muskogee site were determined in order to establish baseline conditions against which measured on-site radioactivity could be compared. The background soil radioactivity was determined by obtaining soil samples from 30 off-site locations near the Fansteel facility as shown in Figure 4-10. The sampling locations were selected in areas assumed to be unaffected by Fansteel's operations at the Muskogee site. The soil samples were submitted for laboratory radiochemical analysis to determine the concentrations of total uranium, total thorium, ^{226}Ra (^{238}U decay series daughter), and ^{228}Ra (^{232}Th decay series daughter). Gross alpha and gross beta activity concentrations were also calculated using the laboratory analysis results. The results of the laboratory analyses and the gross alpha/beta activity calculations are listed in Table 4-1 and discussed below.

The average total uranium and thorium activity concentrations were 1.1 ± 0.6 pCi/g and 3.3 ± 0.9 pCi/g respectively. The maximum total uranium and thorium activity concentrations were 3.1 pCi/g and 5.9 pCi/g respectively. As expected for secular equilibrium and geochemistry conditions in undisturbed soil, the results for ^{226}Ra and ^{228}Ra were very similar to the divided uranium and thorium results at 1.0 ± 0.1 pCi/g and 1.2 ± 0.2 pCi/g respectively. The maximum concentrations of ^{226}Ra and ^{228}Ra were 1.1 ± 0.2 pCi/g and 1.4 ± 0.2 pCi/g respectively. Comparison of the arithmetic and geometric mean results of the data suggested that the underlying distributions had very slight lognormal tendencies which is an expected outcome for some environmental radioactivity data.

The average calculated gross alpha activity concentration was 16 pCi/g with a maximum result of 22 ± 6 pCi/g. The average calculated gross beta activity concentration was 21 pCi/g with a maximum result of 28 ± 5 pCi/g. The calculated gross alpha activity concentrations are elevated; however, this finding likely reflects emissions fallout from the nearby Oklahoma Gas & Electric (OG&E) coal-fired power plant that was placed in service in the early 1970s. The Muskogee site would have been subject to approximately the same amount of fallout as the background soil sample locations.

Based on the soil sample locations selected and the data obtained, Fansteel concludes that the results are representative of unimpacted soils in the region.

Table 4-1 Background Soil Radioactivity Concentrations of Radionuclides of Interest at the Muskogee Site (pCi/g)¹

Sample No.	Gross Alpha	Gross Beta	Total U ²	²²⁶ Ra	²²⁸ Ra	Total Th ³
1	14 ± 5	21 ± 5	0.3	0.96 ± 0.13	1.2 ± 0.2	3.2
2	11 ± 6	26 ± 6	0.3	0.97 ± 0.13	1.2 ± 0.2	2.8
3	10 ± 5	8 ± 5	0.8	0.86 ± 0.13	0.52 ± 0.15	1.0
4	20 ± 6	23 ± 5	0.8	0.90 ± 0.13	1.3 ± 0.2	2.4
5	16 ± 6	26 ± 5	1.0	0.90 ± 0.13	1.1 ± 0.2	4.9
6	21 ± 6	24 ± 5	0.8	0.81 ± 0.13	1.4 ± 0.2	5.9
7	20 ± 4	23 ± 5	0.8	0.88 ± 0.13	1.2 ± 0.2	2.7
8	18 ± 6	19 ± 5	0.9	0.83 ± 0.13	1.3 ± 0.2	4.7
9	20 ± 4 ⁴	13 ± 5	3.1	1.1 ± 0.1	0.65 ± 0.15	2.2
10	18 ± 6	21 ± 5	0.7	1.0 ± 0.1	1.4 ± 0.1	4.2
11	13 ± 5	25 ± 5	1.5	0.95 ± 0.12	1.3 ± 0.2	2.9
12	16 ± 5	14 ± 5	1.6	0.99 ± 0.14	1.2 ± 0.2	3.4
13	18 ± 5	18 ± 5	1.3	1.1 ± 0.1	1.4 ± 0.2	4.1
14	18 ± 6	18 ± 5	1.6	1.0 ± 0.1	0.96 ± 0.22	3.3
15	22 ± 6	15 ± 5	2.1	0.95 ± 0.12	1.4 ± 0.2	3.4
16	13 ± 5	22 ± 5	1.6	1.1 ± 0.1	1.2 ± 0.2	3.7
17	11 ± 5	23 ± 5	1.0	0.92 ± 0.13	1.0 ± 0.2	3.5
18	20 ± 6	18 ± 5	1.3	0.80 ± 0.12	1.2 ± 0.2	3.0
19	13 ± 5	24 ± 5	0.3	0.91 ± 0.11	1.1 ± 0.2	3.7
20	18 ± 6	18 ± 5	1.4	1.1 ± 0.2	1.4 ± 0.2	2.5
21	14 ± 5	24 ± 5	0.9	1.1 ± 0.1	1.4 ± 0.2	2.9
22	12 ± 5	24 ± 5	1.1	0.91 ± 0.14	1.1 ± 0.2	3.2
23	18 ± 6	24 ± 5	1.1	1.0 ± 0.1	1.1 ± 0.2	3.1
24	10 ± 4	13 ± 5	0.8	0.95 ± 0.12	0.87 ± 0.12	3.7
25	11 ± 5	22 ± 5	0.2	0.74 ± 0.12	1.1 ± 0.2	3.6
26	19 ± 6	25 ± 5	1.4	0.98 ± 0.13	1.2 ± 0.2	3.9
27	15 ± 6	19 ± 5	0.7	0.98 ± 0.14	0.95 ± 0.21	3.7

Sample No.	Gross Alpha	Gross Beta	Total U ²	²²⁶ Ra	²²⁸ Ra	Total Th ³
28	17 ± 5	19 ± 5	1.7	0.95 ± 0.13	1.2 ± 0.2	3.5
29	13 ± 5	19 ± 5	1.5	0.81 ± 0.14	0.98 ± 0.21	2.2
30	18 ± 6	28 ± 5	0.1	1.1 ± 0.1	1.4 ± 0.2	2.7
Mean	16 ± 53 ⁵	21 ± 28 ⁵	1.1	1.0 ± 0.7 ⁵	1.2 ± 1.1 ⁵	3.3
Std Dev	4.3	4.6	0.6	0.10	0.2	0.9
Geo Mean	15	20	0.9	0.9	1.1	3.2
Minimum	10 ± 5	8 ± 5	0.1	0.74 ± 0.12	0.52 ± 0.15	1.0
Maximum	22 ± 6	28 ± 5	3.1	1.1 ± 0.2	1.4 ± 0.2	5.9

1. Reference Table 17 of the 1993 remedial assessment report.
2. Includes ²³⁴U, ²³⁵U, and ²³⁸U.
3. Includes ²²⁸Th, ²³⁰Th, and ²³²Th.
4. Original value erroneously reported as 2 ± 4; replaced with the estimate shown.
5. Measurement uncertainty was propagated in quadrature.

4.3.2.2 Surface Soil Sample Results

Each of 0- to 6-inch intervals of the 67 soil borings (numbered B1 through B74, some numbers not used) and 25 monitoring wells (numbered MW-51S through MW-75S) were analyzed for radioactivity. The results are presented in Table 4-2. Total uranium (U-238 + U-235 + U-234) and total thorium (Th-232 + Th-230 + Th-228) are calculated for comparison to the background values established for the site in Section 4.3.2.1. Ratios between radionuclides of the uranium decay chain and between members of the thorium decay chain are presented in Table 4-3 for all surface samples analyzed for individual radionuclides. In addition, the ratio of U-238 and Th-232, the parents of the uranium and thorium chains respectively, is presented. The above-background uranium and thorium identified in surface soil are present in oxide form.

Table 4-2 Summary of 1993 Characterization Results for Surface Soil

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	0.5	1.2	0.3	0.0	0.3	0.9	0.7	1.0
Max	160.0	89.0	17.0	0.8	18.0	12.0	14.0	11.0
Avg	26.7	26.3	3.4	0.2	3.6	3.0	4.8	2.9
Std Dev	28.6	14.7	3.6	0.2	3.7	2.4	4.0	2.3
Number	96	96	29	29	29	29	29	29

Table 4-3 Summary of 1993 Characterization Nuclide Ratio Results for Surface Soil

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	U-234/ U-238	Th-230/ U-238	Ra-226/ U-238	Th-228/ Th-232	Ra-228/ Th-232	U-238/ Th-232
Min	0.4	0.4	0.6	0.1	0.5	0.6	0.6	0.2
Max	10.6	10.6	1.4	22.0	6.8	2.2	2.6	4.7
Avg	4.7	4.7	0.9	2.3	1.8	1.1	1.1	1.3
Std Dev	3.1	3.1	0.2	3.9	1.3	0.3	0.4	1.0
Number	25	25	29	29	25	29	29	29

*Ra-228 inferred from Ac-228 gamma spectrometry result. Ra-226 gamma spectrometry result adjusted for U-235 activity co-identified by gamma spectrometry.

4.3.2.3 Subsurface Soil Sample Results

Each of the 67 soil borings (numbered B1 through B74, some numbers not used) and 25 monitoring wells (numbered MW-51S through MW-75S) had at least 1 subsurface segment analyzed for radioactivity. The results are presented in Table 4-4. Total uranium (U-238 + U-235 + U-234) and total thorium (Th-232 + Th-230 + Th-228) are calculated for comparison to the background values established for the site in Section 4.3.2.1. Ratios between radionuclides of the uranium decay chain and between members of the thorium decay chain are presented in Table 4-5 for all surface samples analyzed for individual radionuclides. In addition, the ratio of U-238 and Th-232, the parents of the uranium and thorium chains respectively, is presented. The above-background uranium and thorium identified in subsurface soil are present in oxide form.

Table 4-4 Summary of 1993 Characterization Results for Subsurface Soil

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	0.5	0.5	0.3	0.0	0.4	0.6	0.4	0.7
Max	360.0	130.0	54.0	2.3	59.0	20.0	30.0	21.0
Avg	19.6	24.2	8.6	0.4	9.2	3.3	4.7	3.0
Std Dev	36.7	17.2	13.7	0.7	14.9	4.9	7.2	4.8
Number	162	162	25	25	25	25	25	25

Table 4-5 Summary of 1993 Characterization Nuclide Ratio Results for Subsurface Soil

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	U-234/ U-238	Th-230/ U-238	Ra-226/ U-238	Th-228/ Th-232	Ra-228/ Th-232	U-238/ Th-232
Min	0.6	0.0	0.4	0.0	0.0	0.5	0.5	0.2
Max	20.0	27.2	1.5	5.1	22.9	2.4	2.4	73.8
Avg	3.2	5.5	1.0	1.3	2.3	1.2	1.2	8.0
Std Dev	4.6	6.3	0.2	1.1	4.5	0.5	0.4	19.3
Number	25	25	25	25	25	25	25	25

*Ra-228 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

4.4 Surface Water, Sediment, and Ponds Characterization

The Muskogee site contains several residue ponds in addition to surface water. The ponds were sampled by coreboring and the resulting samples were analyzed using the same protocol as soil coreboring samples (see Section 4.3).

4.4.1 Ponds

The ponds were sampled at 25 different locations:

- Pond No. 2 WIP residue (three locations)
- Pond No. 3 WIP residue (five locations)
- Pond No. 5 primarily CaF and wastewater treatment, interim WIP residues (three locations)
- Pond No. 6 CaF and wastewater treatment
- Pond No. 7 CaF and wastewater treatment
- Pond No. 8 CaF and wastewater treatment
- Pond No. 9 CaF and wastewater treatment

Samples were analyzed for a number of radiological and chemical parameters including uranium, thorium, gross alpha, and gross beta. Refer to Figure 4-11 for the location of the ponds and the sample locations within each pond.

4.4.1.1 Pond Nos. 2 and 3

At each sample location for Pond Nos. 2 and 3, a sample of the entire column of process residue was obtained. The sample was divided into thirds by vertical interval. Since ore-processing residues retain the radioactive species that were present in the ores processed at the facility, all samples exhibited significant radioactivity. Uranium and thorium were present in all samples at hundreds of pCi/g. Evaluation of the decay product activities showed that the residues were in approximate equilibrium. The summary results are presented in Tables 4-6 through 4-9.

Table 4-6 Summary of 1993 Characterization Results for Pond No. 2

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	2,300.0	920.0	170.0	5.3	170.0	160.0	420.0	160.0
Max	6,700.0	3,100.0	550.0	29.0	580.0	560.0	860.0	560.0
Avg	4,477.8	2,091.1	344.4	15.2	356.7	360.0	696.7	360.0
Std Dev	1,465.2	644.4	140.2	7.7	148.2	131.1	132.3	131.1
Number	9	9	9	9	9	9	9	9

Table 4-7 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 2

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	160.0	137.8	1.2	0.3	0.9	19.2	0.6
Max	560.0	328.9	3.6	1.3	1.0	32.1	1.7
Avg	360.0	232.5	2.2	0.8	1.0	25.1	1.0
Std Dev	131.1	66.8	0.8	0.3	0.0	5.5	0.4
Number	9	9	9	9	9	9	9

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-8 Summary of 1993 Characterization Results for Pond No. 3

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	840.0	610.0	170.0	12.0	180.0	94.0	210.0	94.0
Max	7,600.0	3,800.0	1,000.0	46.0	1,100.0	680.0	1,200.0	680.0
Avg	5,262.7	2,674.0	598.0	30.2	634.7	436.9	766.0	436.9
Std Dev	1,700.9	861.4	263.8	12.3	286.9	136.1	250.3	136.1
Number	15	15	15	15	15	15	15	15

Table 4-9 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 3

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	94.0	-141.5	0.5	-0.3	0.9	11.0	0.7
Max	680.0	400.7	2.7	1.1	1.0	29.0	2.0
Avg	436.9	143.5	1.4	0.3	0.9	21.1	1.5
Std Dev	136.1	153.7	0.6	0.4	0.0	4.65	0.4
Number	15	15	15	15	15	15	15

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

4.4.1.2 Pond No. 5

Pond No. 5 is a dry basin that has been used both for storage of ore-processing residues and for wastewater treatment. The WIP residues have been substantially removed. An accumulation of wastewater treatment residues remains in the basin. Sampling and analysis of materials remaining in Pond No. 5 revealed radioactivity in excess of 20 pCi/g gross alpha and uranium and thorium at elevated concentrations throughout the pond. Radioactivity levels in the Pond No. 5 materials are slightly higher than the levels found in the other wastewater treatment ponds. The summary results are presented in Tables 4-10 and 4-11 below.

Table 4-10 Summary of 1993 Characterization Results for Pond No. 5

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	16.0	17.0	0.6	0.0	0.4	0.9	0.4	0.9
Max	390.0	170.0	97.0	5.0	97.0	24.0	38.0	24.0
Avg	120.3	63.9	21.0	1.0	21.2	6.1	9.2	6.1
Std Dev	119.8	56.5	31.1	1.6	31.3	7.2	11.7	7.2
Number	9	9	9	9	9	9	9	9

Table 4-11 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 5

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	0.9	-25.3	0.1	-0.3	0.9	16.7	0.3
Max	24.0	16.3	1.1	4.3	1.5	70.0	20.6
Avg	6.1	1.8	0.7	1.0	1.1	31.3	3.9
Std Dev	7.2	11.1	0.4	1.3	0.2	18.8	6.3
Number	9	9	9	9	9	7	9

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

4.4.1.3 Pond Nos. 6, 7, 8 and 9

Wastewater treatment ponds (Pond Nos. 6, 7, 8, and 9), located in the southeast corner of the Fansteel property, were sampled at several locations. Pond Nos. 6 and 7 are the final polishing basins where treated wastewater is retained prior to discharge. Only a small amount of residue was present in each of these ponds. Consequently, only one sample increment was obtained from each sample location associated with Pond Nos. 6 and 7. Pond Nos. 8 and 9 were essentially full of wastewater treatment residue. Each sample from Pond Nos. 8 and 9 was divided into three parts in the same manner as the samples from the ore-processing residue impoundments. All of the wastewater treatment residue samples contain

radioactivity in excess of 20 pCi/g gross alpha. The summary results are presented in Tables 4-12 thru 4-19 below.

Table 4-12 Summary of 1993 Characterization Results for Pond No. 6

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	110.0	55.5	8.4	0.3	8.6	4.5	8.0	4.5
Max	150.0	67.0	17.0	2.4	19.0	4.6	8.2	4.6
Avg	130.0	61.0	12.7	1.4	13.8	4.6	8.1	4.6
Std Dev	28.3	8.5	6.1	1.5	7.4	0.1	0.1	0.1
Number	2	2	2	2	2	2	2	2

Table 4-13 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 6

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	4.5	-24.5	0.4	-1.3	0.9	7.9	1.9
Max	4.6	7.1	1.0	0.8	1.0	28.7	4.1
Avg	4.6	-8.7	0.7	-0.2	0.9	18.3	3.0
Std Dev	0.1	22.3	0.4	1.5	0.1	14.7	1.6
Number	2	2	2	2	2	2	2

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-14 Summary of 1993 Characterization Results for Pond No. 7

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	310.0	130.0	26.0	1.3	25.0	15.0	24.0	15.0
Max	680.0	270.0	74.0	3.9	81.0	37.0	54.0	37.0
Avg	495.0	200.0	50.0	2.6	53.0	26.0	39.0	26.0
Std Dev	261.6	99.0	33.9	1.8	39.6	15.6	21.2	15.6
Number	2	2	2	2	2	2	2	2

Table 4-15 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 7

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	15.0	10.6	0.7	0.3	0.9	19.2	1.7
Max	37.0	27.8	1.0	0.4	1.0	20.8	2.2
Avg	26.0	19.2	0.8	0.4	1.0	20.0	1.9
Std Dev	15.6	12.2	0.2	0.1	0.1	1.1	0.4
Number	2	2	2	2	2	2	2

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-16 Summary of 1993 Characterization Results for Pond No. 8

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	120.0	59.0	9.6	0.7	9.9	4.5	6.8	4.5
Max	360.0	190.0	74.0	2.7	73.0	23.0	29.0	23.0
Avg	210.0	100.5	28.3	1.3	29.3	10.5	13.9	10.5
Std Dev	82.5	35.8	14.7	0.5	14.4	6.5	6.7	6.5
Number	15	15	15	15	15	15	15	15

Table 4-17 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 8

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	4.5	-6.7	0.2	-0.3	0.9	14.0	1.0
Max	23.0	15.5	1.3	0.7	1.0	33.8	6.9
Avg	10.5	6.8	0.6	0.2	1.0	22.3	3.7
Std Dev	6.5	6.2	0.4	0.2	0.0	6.9	2.1
Number	15	15	15	15	15	15	15

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-18 Summary of 1993 Characterization Results for Pond No. 9

	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)
Min	21.0	24.0	7.1	0.4	7.6	0.0	0.9	0.0
Max	100.0	100.0	53.0	4.0	57.0	5.4	14.0	5.4
Avg	51.3	50.1	19.9	1.4	22.0	2.1	5.7	2.1
Std Dev	24.2	23.3	14.1	1.1	14.7	1.6	4.6	1.6
Number	12	12	12	12	12	12	12	12

Table 4-19 Summary of 1993 Characterization Nuclide Ratio Results for Pond No. 9

	Ra-228 (pCi/g)*	Ra-226 (pCi/g)*	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
Min	0.0	-52.9	0.0	-2.0	0.8	6.5	2.8
Max	5.4	2.8	0.9	0.2	1.0	34.0	17.1
Avg	2.1	-8.1	0.3	-0.4	0.9	18.8	11.6
Std Dev	1.6	14.8	0.3	0.6	0.1	7.9	4.2
Number	12	12	12	12	12	12	11

*Ra-228, Th-228, and Th-232 inferred from Ac-228 gamma spectroscopy result. Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

4.4.2 Surface Water and Sediment Sampling

A total of seven surface water and six surface sediment samples were collected at the locations identified in Figure 4-11. A sediment sample was obtained at each surface water sample location for comparison. However, one sample location (Outfall 001) had no sediment available. Surface water samples were analyzed for gross alpha and gross beta. Generally, if gross alpha was detected in excess of 15 picocuries per liter (pCi/L) or gross beta was detected in excess of 50 pCi/L, the sample was analyzed for individual radionuclides. Sediment samples were also analyzed for gross alpha and gross beta. Generally, if gross alpha or gross beta was detected at levels significantly above background, the sample was analyzed for individual radionuclides. The summary results of the sample analyses are presented in Tables 4-20 and 4-21 below.

Table 4-20 Summary of 1993 Characterization Results for Sediment Samples

Sample ID	Concentration (pCi/g)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226 ¹	Ra-228 ²
SS-002	28	26	2.7	0.1	2.8	1.2	1.7	1.2	3.9	1.6
SS-003	24	32	5.9	0.6	6.5	1.7	3.2	1.8	1.8	1.4
SS-005	16	17	-	-	-	-	-	-	0.0	-
SS-1 ⁴	110	150	8.9	-0.1	5.4	-	8.6	-	0.0	-
SS-2	18	18	-	-	-	-	-	-	0.0	-
SS-3	15	28	-	-	-	-	-	-	0.0	-
Min	15.0	17.0	2.7	-0.1	2.8	1.2	1.7	1.2	0.0	1.4
Max	110.0	150.0	8.9	0.6	6.5	1.7	8.6	1.8	3.9	1.6
Avg	35.2	45.2	5.8	0.2	4.9	1.5	4.5	1.5	0.9	1.5
Std Dev	37.0	51.7	3.1	0.4	1.9	0.4	3.6	0.4	1.6	0.1
Number			6	6	6	6	6	6	6	6

¹U-234 and U-238 data from alpha spectroscopy.

²Th-228 and Th-232 data from alpha spectroscopy.

³Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectrometry.

⁴The 1993 report identifies the results for both sediment and surface water as identical which is highly unlikely.

Table 4-21 Summary of 1993 Characterization Results for Surface Water Samples

Sample ID	Concentration (pCi/L)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
SS-001	4	8	-	-	-	-	-	-	-	-
SS-002	45	70	8.3	0.5	8.2	1.8	1.3	1.8	3.4	1.5
SS-003	2	4	-	-	-	-	-	-	-	-
SS-005	3	7	-	-	-	-	-	-	-	-
SS-1	110	150	8.9	-0.1	5.4	14	8.6	17.0	5.9	11.0
SS-2	2	7	-	-	-	-	-	-	-	-
SS-3	3	8	-	-	-	-	-	-	-	-
Min	2.0	4.0	8.3	-0.1	5.4	1.8	1.3	1.8	3.4	1.5
Max	110.0	150.0	8.9	0.5	8.2	14.0	8.6	17.0	5.9	11.0
Avg	27.5	41.0	8.6	0.2	6.8	7.9	5.0	9.4	4.7	6.3
Std Dev	43.8	59.1	0.4	0.4	2.0	8.6	5.2	10.7	1.8	6.7
Number			7	7	7	7	7	7	7	7

4.5 Groundwater Characterization

4.5.1 1993 Remediation Assessment Activities

During the 1993 remediation assessment conducted at the Fansteel site, a total of 29 groundwater monitoring wells (identified as MW-51S through MW-75S, MW-151D, MW-161D, MW-167D, and MW-174D) were installed to determine the radiological character of groundwater (Figure 4-12). Shallow monitoring wells (MW-51S through MW-75S) were installed within the alluvium at the top of bedrock. Deep monitoring wells (MW-151D, MW-161D, MW-167D, and MW-174D) were installed to communicate with fractures within the uppermost bedrock shale unit (McCurtain Shale). These series of wells provided for the evaluation of groundwater radiochemistry within the two uppermost continuous zones of saturation beneath the site.

Groundwater samples were analyzed for gross alpha and gross beta activity concentrations in pCi/L. If the gross alpha activity was detected in excess of 15 pCi/L or the gross beta activity was detected in excess of 50 pCi/L in a sample, individual radionuclide analyses were performed to determine the contributing species. Results of these analyses are discussed below.

4.5.1.1 Unconsolidated Zone of Saturation (Shallow Wells)

During the 1993 remediation assessment, groundwater in the unconsolidated zone of saturation exhibited radioactive contamination over the southeast portion of the site. All but three of the monitoring wells

installed to communicate with the unconsolidated zone of saturation exhibited some degree of radiological contamination.

Groundwater Wells MW-52S and MW-56S are located in the borrow pit area (the southwest corner of the property). Both of these wells exhibited elevated gross alpha radioactivity. Groundwater samples from Well MW-52S contained 79 pCi/L and 160 pCi/L respectively of gross alpha and gross beta radioactivity. Groundwater sampled from Well MW-56S contained 76 pCi/L and 34 pCi/L of gross alpha and gross beta radioactivity. Additionally, groundwater sampled from Well MW-56S contained 68 pCi/L of uranium. Groundwater sampled from Well MW-52S contained elevated concentrations of radium and thorium.

Monitoring Wells MW-57S, MW-59S, MW-60S, MW-61S, and MW-62S are located along the eastern (downgradient) side of the wastewater treatment residue impoundments. Wells MW-59S, MW-60S, and MW-57S exhibited elevated gross alpha and gross beta radioactivity. Wells MW-61S and MW-62S showed elevated gross beta radioactivity only. The source of this groundwater contamination probably is the wastewater treatment residue impoundments that may have experienced partial loss of liner integrity (Pond Nos. 5, 6, and 7 have clay liners; Pond Nos. 8 and 9 have synthetic liners).

Groundwater samples from three wells (MW-65S, MW-66S, and MW-67S) located in the east outslope area, directly east of the main process area of the plant, exhibited elevated gross alpha and gross beta radioactivity. Of these wells, Well MW-65 showed the least contamination with 19 pCi/L gross alpha and 100 pCi/L gross beta activity. This well is located most upgradient of the three wells in this area and is removed from the majority of the contaminated soils previously identified. Well MW-66S exhibited 140 pCi/L of gross alpha radioactivity and 120 pCi/L of gross beta radioactivity. Well MW-67S is the most contaminated well in the area with 1,300 pCi/L gross alpha radioactivity and 440 pCi/L gross beta radioactivity.

Eight monitoring wells (MW-68S, MW-70S, MW-71S, MW-73S, MW-74S, MW-72S, MW-75S, and MW-69S) surround the ore-processing residue impoundments, Pond No. 2, and Pond No. 3. Wells MW-72S and MW-75S, located north and east of Pond No. 3, did not exhibit contamination by radioactive materials. Groundwater sampled from Well MW-70S showed only a gross beta radioactivity above the water quality criteria.

The former Pond No. 2 was a clay-lined WIP residue impoundment. Consequently, the wells associated with this impoundment are strongly affected. Groundwater sampled from Well MW-73S contained 830 pCi/L of gross alpha radioactivity and 1,300 pCi/L of gross beta radioactivity. Well MW-74S, located downgradient and immediately adjacent to Pond No. 2, exhibited 2,600 pCi/L of gross alpha radioactivity and 930 pCi/L of gross beta radioactivity. Well MW-71, which is located on the upgradient side of Pond No. 2, exhibited only 29 pCi/L of gross alpha and 140 pCi/L gross beta radioactivity.

Monitoring Well MW-68S, located on the west side of Pond No. 3, and Well MW-69S, located on the north side of Pond No. 3, exhibited contamination. Groundwater sampled from Well MW-68S contained 52 pCi/L of gross alpha radioactivity and 59 pCi/L of gross beta radioactivity. Groundwater sampled from Well MW-69S contained 30 pCi/L of gross alpha activity. Gross beta radioactivity in this well was less than the criterion concentration of 50 pCi/L. Both MW-68S and MW-69S are located in areas that were potentially affected by the synthetic lining failure in Pond No. 3. Radioactive contamination was absent in other wells in the proximity of Pond No. 3.

Monitoring Wells MW-63S, MW-64S, and MW-55S are located in the central area immediately west of the main processing area where soil analysis showed little, if any, radioactive contamination present. Groundwater samples obtained from Wells MW-63S and MW-64S exhibited elevated gross beta radioactivity, but not elevated gross alpha radioactivity. MW-55S exhibited elevated gross alpha radioactivity at 40 pCi/L, but did not exhibit elevated gross beta radioactivity. MW-55S is in an area that was potentially affected by the release of materials from Pond No. 3. A summary of 1993 characterization survey results for groundwater samples is shown in Table 4-22.

Table 4-22 Summary of 1993 Characterization Results for Groundwater Samples

Sample ID	Concentration (pCi/L)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
MW-51S	8	8	NA	NA	NA	NA	NA	NA	NA	NA
MW-52S	79	160	0.7	0.0	0.9	6.4	4.0	5.6	4.1	5.9
MW-53S	6	10	NA	NA	NA	NA	NA	NA	NA	NA
MW-54S	15	25	NA	NA	NA	NA	NA	NA	NA	NA
MW-55S	40	36	1.4	-0.1	1.3	1.9	1.0	1.6	2	3
MW-56S	76	34	37	2.2	29	0.7	0.6	0.4	0.5	1.4
MW-57S	23	120	1.9	-0.1	0.8	1.5	0.9	1.2	1.4	2
MW-58S	5	45	NA	NA	NA	NA	NA	NA	NA	NA
MW-59S	19	110	NA	NA	NA	NA	NA	NA	NA	NA
MW-60S	24	240	0.4	-0.1	-0.1	1.7	0.4	1.1	3.2	2.2

Sample ID	Concentration (pCi/L)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
MW-61S	-2	150	0.7	-0.1	0.4	0.3	0.2	0.2	1	1.4
MW-62S	2	200	4.3	0.2	3.6	0.5	0.3	0.1	NA	NA
MW-63S	-13	210	0.2	0.0	0.2	0.1	0.4	0.0	NA	NA
MW-64S	12	130	6.2	0.4	7	1.1	0.8	0.9	NA	NA
MW-65S	19	100	3	0.0	3.1	0.9	0.7	0.6	NA	NA
MW-66S	140	120	970	40	980	0.4	0.5	0.6	NA	NA
MW-67S	1,300	440	900	42	900	0.5	2.4	0.0	NA	NA
MW-68S	52	59	1.5	0.0	1.3	3	1.5	2.3	NA	NA
MW-69S	30	24	0.7	0.0	0.4	2.1	1.4	1.5	2	2.3
MW-70S	1	370	2.6	0.0	2.1	0.0	0.0	0.1	NA	NA
MW-71S	29	140	19	1.1	21	1.4	1.7	1.1	NA	NA
MW-72S	7	10	NA	NA	NA	NA	NA	NA	NA	NA
MW-73S	830	1,300	42	8.9	35	3.5	1.2	1.4	5.8	11
MW-74S	2,600	930	21,000	2,100	25,000	0.8	0.0	0.5	NA	NA
MW-75S	14	18	NA	NA	NA	NA	NA	NA	NA	NA
Minimum:	-13	8	0.2	-0.1	-0.1	0	0	0	0.5	1.4
Maximum:	2,600	1,300	21,000	2,100	25,000	6.4	4	5.6	5.8	11
Average:	213	200	1,277	122	1,499	1.49	1.00	1.07	2.50	3.65
Stdev.:	579	301	4,931	494	5,873	1.56	0.98	1.30	1.77	3.30
Number:	25	25	18	18	18	18	18	18	8	8

4.5.1.2 Bedrock Zone of Saturation

Water samples from the four deep monitoring wells (MW-151D, MW-161D, MW-167D, and MW-174D) in the bedrock zone were analyzed for gross alpha and gross beta radioactivity. Deep Monitoring Well MW-151D was nested with Shallow Monitoring Well MW-51S located along Tantalum Road west of the Sintering Building. Deep Monitoring Well MW-161D was nested with Shallow Monitoring Well MW-61S located along the eastern (downgradient) side of the wastewater treatment residue impoundments. Deep Monitoring Well MW-167D was nested with Shallow Monitoring Well MW-67S located in the east outslope area, directly east of the main process area of the plant. Deep Monitoring Well MW-174D was nested with Shallow Monitoring Well MW-74S located immediately north of former Pond No. 2. A summary of 1993 characterization survey results for bedrock groundwater samples is shown in Table 4-23 below.

MW-151D initially exhibited gross alpha and gross beta activity concentrations in excess of the Oklahoma Water Resources Board (OWRB) values of 15 pCi/L for alpha radioactivity and 50 pCi/L for beta radioactivity. Subsequent sampling and analysis of water from this well exhibited gross alpha and gross beta activity concentrations below these criteria. The initial concentrations are, therefore, believed to be due to laboratory error or to trace contaminants introduced during well installation or development.

Radionuclide concentrations in the other bedrock monitoring wells were below the OWRB values for alpha and beta radioactivity. Based on these results, it was concluded that radioactive contaminated groundwater beneath the site was confined to the unconsolidated zone of saturation.

Table 4-23 Summary of 1993 Characterization Results for Bedrock Groundwater Samples

Sample ID	Concentration (pCi/L)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
MW-151D	26	52	9.1	0.4	5.0	2.1	0.7	1.3	1.2	0.4
MW-151D (Resample)	3	16	NA	NA	NA	NA	NA	NA	NA	NA
MW-161D	4	8	NA	NA	NA	NA	NA	NA	NA	NA
MW-167D	-1	16	NA	NA	NA	NA	NA	NA	NA	NA
MW-174D	10	10	NA	NA	NA	NA	NA	NA	NA	NA
Minimum:	-1	8	NA	NA	NA	NA	NA	NA	NA	NA
Maximum:	10	16	NA	NA	NA	NA	NA	NA	NA	NA
Average:	4	12.5	NA	NA	NA	NA	NA	NA	NA	NA
Stdev.:	4.5	4.1	NA	NA	NA	NA	NA	NA	NA	NA

Subsequent to several sampling and analysis events, it was concluded that elevated radioactivity was not present in the bedrock monitoring wells. Based on these results, radioactive contamination of groundwater appears to be confined to the alluvium at the top of bedrock. To preclude potential cross contamination with the shallow water aquifer, all of the deep wells were closed and abandoned as approved by the ODEQ in a letter dated April 14, 1995.

4.5.2 Recent Groundwater Monitoring Event Results

The most recent groundwater sampling and analysis event occurred in the spring of 2002. This event included 19 of the 25 alluvial wells that were sampled in 1993 (see Table 4-22); the updated analytical results are listed in Table 4-24. In comparison to the 1993 data, the individual gross alpha radioactivity concentration results were higher in 2002 for 10 of the wells sampled and lower for the remaining 9 wells; the individual gross beta radioactivity concentration results were higher for 7 wells and lower for the remaining 12 wells. The 2002 gross alpha and gross beta radioactivity concentration results for Well MW-67S were markedly higher than those obtained in 1993 (1,300 and 440 pCi/L respectively). Conversely, the gross alpha and gross beta radioactivity concentration results obtained in 1993 for Well MW-74S (2,600 and 930 pCi/L respectively) have declined substantially in 2002 to 329 and 343 pCi/L respectively. The group average analytical results for the gross alpha and gross beta radioactivity concentrations, 146 and 173 pCi/L respectively, have declined from the corresponding values reported for

the 1993 sampling event (213 and 200 pCi/L respectively). It should be noted that the 2002 group average concentrations were predominated by the gross alpha and gross beta radioactivity concentration results for Well MW-67S (2,130 and 1,290 pCi/L respectively) that were included in the averaging data set. As expected, the isotopic data trends for the uranium and thorium series nuclides (radium was not analyzed in 2002) mirrored the surrogate gross alpha and gross beta radioactivity concentration results.

Table 4-24 Summary of 2002 Results for Groundwater Samples

Sample ID	Concentration (pCi/L)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
MW-51S	18.6	13.1	0.6	0.0	0.1	0.6	0.0	0.3	NA	NA
MW-52S	12.9	17.8	NA	NA	NA	NA	NA	NA	NA	NA
MW-53S	21.2	27.6	0.4	0.1	0.5	0.6	0.8	0.5	NA	NA
MW-54S	5.1	4.6	NA	NA	NA	NA	NA	NA	NA	NA
MW-55S	3.2	4.4	NA	NA	NA	NA	NA	NA	NA	NA
MW-56S	26.4	18.9	9.6	0.5	8.3	0.4	0.9	0.3	NA	NA
MW-57S	0.3	143	0.8	0.1	0.6	0.2	0.2	0.0	NA	NA
MW-58S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-59S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-60S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-61S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-62S	21.9	199	9.5	0.6	9.6	0.2	0.2	0.1	NA	NA
MW-63S	6.4	69.3	0.7	0.1	0.6	0.5	0.5	0.3	NA	NA
MW-64S	21.5	73.9	4.3	0.2	4.4	0.7	1.1	0.5	NA	NA
MW-65S	21.8	103	3.8	0.3	3.0	0.6	0.9	0.6	NA	NA
MW-66S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-67S	2130	1290	774	28.1	768	1	1.9	0.2	NA	NA
MW-68S	13.6	18.4	NA	NA	NA	NA	NA	NA	NA	NA
MW-69S	12.2	8.4	NA	NA	NA	NA	NA	NA	NA	NA
MW-70S	30.7	807	3.5	0.1	2.4	0.1	0.2	0.2	NA	NA
MW-71S	70.7	107	36.9	1.5	40	0.3	0.3	0.2	NA	NA
MW-72S	20.7	24.4	2.7	0.2	2.1	0.1	0.0	0.0	NA	NA
MW-73S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-74S	329	343	69.4	2.8	70.6	1.4	0.9	0.9	NA	NA
MW-75S	3.6	10.1	0.4	0.0	0.4	0.2	0.0	0.1	NA	NA
Minimum:	0.3	4.4	0.4	0.0	0.1	0.1	0.0	0.0		
Maximum:	2130	1290	774	28.1	768	1.4	1.9	0.9		
Average:	146	173	65	2.5	65	0.5	0.6	0.3		
Stdev.:	486	330	205	7.4	203	0.4	0.5	0.3		
Number:	19	19	14	14	14	14	14	14		

Reference

1. Earth Sciences Consultants, Inc., December 1993, Remediation Assessment, Fansteel Inc., Muskogee, Oklahoma.

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Tables

Table 4-1
Surface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
BKG	Surface	15.6	20.5	-	-	-	-	-	-	0.8	3.3	1.16	0.95
B3	0-2	2.3	3	-	-	-	-	-	-	-	-	-	-
B5	0-0.5	14	22	-	-	-	-	-	-	-	-	-	-
B6	0-0.5	15	23	-	-	-	-	-	-	-	-	-	-
B7	0-0.5	12	18	-	-	-	-	-	-	-	-	-	-
B8	0-0.5	60.0	40.0	3.4	0.0	2.8	4.6	3.6	4.8	6.2	13.0	5.3	4.9
B9	0-0.5	14.0	24.0	-	-	-	-	-	-	-	-	-	-
B10	0-0.5	18.0	27.0	-	-	-	-	-	-	-	-	-	-
B11	0.5-2	18.0	22.0	-	-	-	-	-	-	-	-	-	-
B11	0-0.5	18.0	21.0	-	-	-	-	-	-	-	-	-	-
B12	0-0.5	14.0	20.0	-	-	-	-	-	-	-	-	-	-
B13	0.5-2.5	17.0	22.0	-	-	-	-	-	-	-	-	-	-
B13	0-0.5	21.0	26.0	-	-	-	-	-	-	-	-	-	-
B14	0-0.5	28.0	24.0	0.5	0.1	0.5	1.4	0.9	1.2	1.1	3.5	1.4	0.4
B15	0-0.5	38.0	27.0	0.5	0.4	0.7	2.4	1.6	1.1	1.6	5.1	2.4	-
B17	0.5-2.5	27.0	22.0	0.3	0.0	0.5	2.7	11.0	2.6	0.8	16.3	1.9	3.4
B17	0-0.5	6.0	5.0	-	-	-	-	-	-	-	-	-	-
B19	0-0.5	17.0	19.0	-	-	-	-	-	-	-	-	-	-
B22	0-0.5	56.0	42.0	3.6	0.3	3.3	2.1	6.1	2.1	7.2	10.3	2.2	3.5
B23	0-0.5	14.0	23.0	-	-	-	-	-	-	-	-	-	-
B24	0-0.5	16.0	19.0	-	-	-	-	-	-	-	-	-	-
B25	0-0.5	20.0	23.0	-	-	-	-	-	-	-	-	-	-
B26	0.5-2	10.0	27.0	-	-	-	-	-	-	-	-	-	-
B26	0-0.5	15.0	26.0	-	-	-	-	-	-	-	-	-	-
B27	0-0.5	15.0	31.0	-	-	-	-	-	-	-	-	-	-
B28	0-0.5	22.0	20.0	0.3	0.1	0.3	2.0	1.4	1.8	0.7	5.2	1.3	0.4
B29	0.5-2.5	14.0	26.0	5.6	0.6	6.1	1.3	0.7	1.3	12.3	3.3	3.4	-
B29	0-0.5	46.0	32.0	3.6	0.2	3.6	1.9	2.6	1.9	7.4	6.4	2.2	-
B31	0.5-2.5	16.0	21.0	-	-	-	-	-	-	-	-	-	-

Table 4-1
Surface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
B31	0-0.5	19.0	23.0	-	-	-	-	-	-	-	-	-	-
B32	0-0.5	27.0	28.0	1.3	0.1	1.7	4.0	4.6	2.5	3.1	11.1	1.6	2.0
B33	0-0.5	16.0	19.0	-	-	-	-	-	-	-	-	-	-
B34	0-0.5	11.0	16.0	-	-	-	-	-	-	-	-	-	-
B35	0-0.5	8.0	21.0	-	-	-	-	-	-	-	-	-	-
B36	0-0.5	27.0	22.0	0.8	0.0	1.1	1.0	1.2	1.0	1.9	3.2	0.9	2.2
B38	0-0.5	27.0	27.0	1.3	0.1	0.9	1.5	1.4	1.7	2.3	4.6	1.9	-
B42	0.5-2	17.0	30.0	-	-	-	-	-	-	-	-	-	-
B47	0.5-2.5	93.0	53.0	5.1	0.4	5.8	7.0	11.0	8.1	11.3	26.1	6.6	4.3
B47	0-0.5	11.0	29.0	-	-	-	-	-	-	-	-	-	-
B48	0-0.5	11.0	26.0	-	-	-	-	-	-	-	-	-	-
B49	0.5-2.0	61.0	33.0	3.7	0.1	4.1	2.5	5.0	2.4	7.9	9.9	2.6	6.3
B49	0-0.5	42.0	44.0	3.2	0.1	3.5	2.4	4.6	2.7	6.8	9.7	2.9	5.4
B50	0.5-2.0	31.0	27.0	1.9	0.0	2.0	1.4	1.5	1.4	3.9	4.3	1.5	3.5
B50	0-0.5	61.0	34.0	4.2	0.2	4.8	1.8	3.4	1.7	9.2	6.9	2.2	3.5
B51	0.5-2.5	74.0	48.0	2.3	0.1	2.2	4.7	5.4	4.1	4.6	14.2	4.6	8.6
B51	0-0.5	4.0	27.0	-	-	-	-	-	-	-	-	-	-
B52	0.5-2.5	55.0	49.0	2.6	0.2	3.3	4.8	5.5	4.3	6.1	14.6	5.5	5.0
B52	0-0.5	6.0	24.0	-	-	-	-	-	-	-	-	-	-
B53	0-0.5	6.0	23.0	-	-	-	-	-	-	-	-	-	-
B54	0.5-2.0	73.0	45.0	4.7	0.1	4.7	2.7	8.7	3.3	9.5	14.7	2.9	10.6
B54	0-0.5	92.0	48.0	6.4	0.2	6.7	2.8	11.0	3.3	13.3	17.1	3.5	9.2
B56	0-0.5	110.0	62.0	9.9	0.3	10.0	12.0	12.0	11.0	20.2	35.0	11	9.7
B57	0-0.5	19.0	21.0	-	-	-	-	-	-	-	-	-	-
B58	0-0.5	29.0	31.0	1.3	0.1	1.4	1.3	2.0	1.5	2.8	4.8	1.6	2.1
B59	0-0.5	10.0	25.0	-	-	-	-	-	-	-	-	-	-
B60	0-0.5	21.0	27.0	0.7	0.0	1.0	1.7	1.5	1.3	1.7	4.5	1	1.8
B61	0-0.5	110.0	61.0	8.3	0.5	7.5	5.0	14.0	4.2	16.3	23.2	4.6	9.9
B62	0-0.5	28.0	28.0	1.0	0.0	0.9	2.0	2.0	1.2	1.9	5.2	1.5	2.6

Table 4-1
Surface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
B63	0-0.5	20.0	27.0	-	-	-	-	-	-	-	-	-	-
B64	0-0.5	18.0	27.0	-	-	-	-	-	-	-	-	-	-
B65	0-0.5	18.0	30.0	-	-	-	-	-	-	-	-	-	-
B66	0-0.5	11.0	23.0	-	-	-	-	-	-	-	-	-	-
B67	0-0.5	14.0	21.0	-	-	-	-	-	-	-	-	-	-
B68	0-0.5	13.0	20.0	-	-	-	-	-	-	-	-	-	-
B69	0.5-2.5	20.0	24.0	-	-	-	-	-	-	-	-	-	-
B69	0-0.5	18.0	29.0	-	-	-	-	-	-	-	-	-	-
B70	0-0.5	14.0	26.0	-	-	-	-	-	-	-	-	-	-
B71	0-0.5	18.0	22.0	-	-	-	-	-	-	-	-	-	-
B72	0-0.5	20.0	29.0	-	-	-	-	-	-	-	-	-	-
B74	0.5-2.5	160.0	89.0	-	-	-	-	-	-	-	-	-	-
B74	0-0.5	130.0	69.0	17.0	0.8	18.0	7.1	9.2	6.0	35.8	22.3	5.4	8.6
MW-51S	0-2	2.4	3.9	-	-	-	-	-	-	-	-	-	-
MW-52S	0-0.5	17.0	24.0	-	-	-	-	-	-	-	-	-	-
MW-53S	0-0.5	38.0	21.0	-	-	-	-	-	-	-	-	-	-
MW-54S	0-0.5	18.0	22.0	-	-	-	-	-	-	-	-	-	-
MW-55S	0-0.5	20.0	27.0	-	-	-	-	-	-	-	-	-	-
MW-56S	0-0.5	23.0	23.0	0.3	0.0	0.5	1.3	0.7	1.2	0.8	3.2	1.2	1.6
MW-57S	0-0.5	18.0	22.0	-	-	-	-	-	-	-	-	-	-
MW-58S	0-0.5	14.0	21.0	-	-	-	-	-	-	-	-	-	-
MW-59S	0-2	1.3	2.8	-	-	-	-	-	-	-	-	-	-
MW-60S	0-0.5	20.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-61S	0-2	0.5	1.5	-	-	-	-	-	-	-	-	-	-
MW-62S	0-2	3.5	4.1	-	-	-	-	-	-	-	-	-	-
MW-63S	0-2	0.8	1.2	-	-	-	-	-	-	-	-	-	-
MW-64S	0-0.5	19.0	26.0	-	-	-	-	-	-	-	-	-	-
MW-65S	0-0.5	22.0	26.0	1.5	0.0	2.3	0.9	0.8	1.6	3.8	3.3	1.4	2.7
MW-66S	0-2	60.0	73.0	-	-	-	-	-	-	-	-	-	-

Table 4-1
Surface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)										Ra-228 ³	Ra-226 ⁴
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²		
MW-67S	0-2	5.9	5.4	-	-	-	-	-	-	-	-	-	-
MW-68S	0-0.5	15.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-69S	0-0.5	13.0	23.0	-	-	-	-	-	-	-	-	-	-
MW-70S	0-2	4.0	8.2	-	-	-	-	-	-	-	-	-	-
MW-71S	0-0.5	8.0	19.0	-	-	-	-	-	-	-	-	-	-
MW-72S	0-2	3.5	4.7	-	-	-	-	-	-	-	-	-	-
MW-73S	0-2	2.9	4.4	-	-	-	-	-	-	-	-	-	-
MW-74S	0-0.5	14.0	23.0	-	-	-	-	-	-	-	-	-	-
MW-75S	0.5-2	14.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-75S	0-0.5	48.0	32.0	3.1	0.1	3.1	2.0	6.1	2.1	6.3	10.2	1.9	4.6
Min:		0.5	1.2	0.3	0.0	0.3	0.9	0.7	1.0	-	-	0.9	0.4
Max:		160.0	89.0	17.0	0.8	18.0	12.0	14.0	11.0	-	-	11.0	10.6
Avg:		26.7	26.3	3.4	0.2	3.6	3.0	4.8	2.9	-	-	3.0	4.7
Std Dev:		28.6	14.7	3.6	0.2	3.7	2.4	4.0	2.3	-	-	2.2	3.1
Count		96	96	29	29	29	29	29	29	-	-	29	25

Footnotes:

- ¹ Total Uranium = U-238 + U-235 + U-234.
² Total Thorium = Th-232 + Th-230 + Th-228
³ Ra-228 activity inferred from Ac-228 activity identified by gamma spectroscopy.
⁴ Ra-226 activity adjusted for presence of U-235 activity (gamma spectroscopy based on ratio of 186 keV gamma yields) = Ra-226 - (U-235 x (0.54/0.038)).

Table 4-2
Surface Soil Sample Results - Activity Ratios
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)								Ratios					
		U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-228 ¹	Ra-226 ²	U-234/ U-238	Th-230/ U-238	Ra-226/ U-238	Th-228/ Th-232	Ra-228/ Th-232	U-238/ Th-232
B14	0-0.5	0.5	0.1	0.5	1.4	0.9	1.2	1.4	0.4	1.00	1.80	0.76	1.17	1.17	0.42
B15	0-0.5	0.5	0.4	0.7	2.4	1.6	1.1	2.4	-	0.71	2.29	-	2.18	2.18	0.64
B17	0.5-2.5	0.3	0.0	0.5	2.7	11.0	2.6	1.9	3.4	0.60	22.00	6.80	1.04	0.73	0.19
B22	0-0.5	3.6	0.3	3.3	2.1	6.1	2.1	2.2	3.5	1.09	1.85	1.07	1.00	1.05	1.57
B28	0-0.5	0.3	0.1	0.3	2.0	1.4	1.8	1.3	0.4	1.00	4.67	1.26	1.11	0.72	0.17
B29	0.5-2.5	5.6	0.6	6.1	1.3	0.7	1.3	3.4	-	0.92	0.11	-	1.00	2.62	4.69
B29	0-0.5	3.6	0.2	3.6	1.9	2.6	1.9	2.2	-	1.00	0.72	-	1.00	1.16	1.89
B32	0-0.5	1.3	0.1	1.7	4.0	4.6	2.5	1.6	2.0	0.76	2.71	1.16	1.60	0.64	0.68
B36	0-0.5	0.8	0.0	1.1	1.0	1.2	1.0	0.9	2.2	0.73	1.09	2.00	1.00	0.90	1.10
B38	0-0.5	1.3	0.1	0.9	1.5	1.4	1.7	1.9	-	1.44	1.56	-	0.88	1.12	0.53
B47	0.5-2.5	5.1	0.4	5.8	7.0	11.0	8.1	6.6	4.3	0.88	1.90	0.74	0.86	0.81	0.72
B49	0.5-2.0	3.7	0.1	4.1	2.5	5.0	2.4	2.6	6.3	0.90	1.22	1.53	1.04	1.08	1.71
B49	0-0.5	3.2	0.1	3.5	2.4	4.6	2.7	2.9	5.4	0.91	1.31	1.54	0.89	1.07	1.30
B50	0.5-2.0	1.9	0.0	2.0	1.4	1.5	1.4	1.5	3.5	0.95	0.75	1.75	1.00	1.07	1.43
B50	0-0.5	4.2	0.2	4.8	1.8	3.4	1.7	2.2	3.5	0.88	0.71	0.72	1.06	1.29	2.82
B51	0.5-2.5	2.3	0.1	2.2	4.7	5.4	4.1	4.6	8.6	1.05	2.45	3.90	1.15	1.12	0.54
B52	0.5-2.5	2.6	0.2	3.3	4.8	5.5	4.3	5.5	5.0	0.79	1.67	1.50	1.12	1.28	0.77
B54	0.5-2.0	4.7	0.1	4.7	2.7	8.7	3.3	2.9	10.6	1.00	1.85	2.25	0.82	0.88	1.42
B54	0-0.5	6.4	0.2	6.7	2.8	11.0	3.3	3.5	9.2	0.96	1.64	1.37	0.85	1.06	2.03
B56	0-0.5	9.9	0.3	10.0	12.0	12.0	11.0	11	9.7	0.99	1.20	0.97	1.09	1.00	0.91
B58	0-0.5	1.3	0.1	1.4	1.3	2.0	1.5	1.6	2.1	0.93	1.43	1.48	0.87	1.07	0.93
B60	0-0.5	0.7	0.0	1.0	1.7	1.5	1.3	1	1.8	0.70	1.50	1.80	1.31	0.77	0.77
B61	0-0.5	8.3	0.5	7.5	5.0	14.0	4.2	4.6	9.9	1.11	1.87	1.32	1.19	1.10	1.79
B62	0-0.5	1.0	0.0	0.9	2.0	2.0	1.2	1.5	2.6	1.11	2.22	2.89	1.67	1.25	0.75
B74	0-0.5	17.0	0.8	18.0	7.1	9.2	6.0	5.4	8.6	0.94	0.51	0.48	1.18	0.90	3.00
B8	0-0.5	3.4	0.0	2.8	4.6	3.6	4.8	5.3	4.9	1.21	1.29	1.75	0.96	1.10	0.58
MW-56S	0-0.5	0.3	0.0	0.5	1.3	0.7	1.2	1.2	1.6	0.60	1.40	3.20	1.08	1.00	0.42

Table 4-2
Surface Soil Sample Results - Activity Ratios
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)								Ratios					
		U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-228 ¹	Ra-226 ²	U-234/ U-238	Th-230/ U-238	Ra-226/ U-238	Th-228/ Th-232	Ra-228/ Th-232	U-238/ Th-232
MW-65S	0-0.5	1.5	0.0	2.3	0.9	0.8	1.6	1.4	2.7	0.65	0.35	1.17	0.56	0.88	1.44
MW-75S	0-0.5	3.1	0.1	3.1	2.0	6.1	2.1	1.9	4.6	1.00	1.97	1.48	0.95	0.90	1.48
	Min:	0.3	0.0	0.3	0.9	0.7	1.0	0.9	0.4	0.6	0.1	0.5	0.6	0.6	0.2
	Max:	17.0	0.8	18.0	12.0	14.0	11.0	11.0	10.6	1.4	22.0	6.8	2.2	2.6	4.7
	Avg:	3.4	0.2	3.6	3.0	4.8	2.9	3.0	4.7	0.9	2.3	1.8	1.1	1.1	1.3
	Std Dev:	3.6	0.2	3.7	2.4	4.0	2.3	2.2	3.1	0.2	3.9	1.3	0.3	0.4	1.0
	Count:	29	29	29	29	29	29	29	25	29	29	25	29	29	29

Footnotes:
¹ Ra-228 activity inferred from Ac-228 activity identified by gamma spectroscopy.
² Ra-226 activity adjusted for presence of U-235 activity (gamma spectroscopy based on ratio of 186 keV gamma yields) = Ra-226 - (U-235 x (0.54/0.038))

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
BKG	Surface	15.6	20.5	-	-	-	-	-	-	0.8	3.3	1.16	0.95
B1	12-14.5	6.7	30.7	-	-	-	-	-	-	-	-	-	-
B1	17-19.5	1.1	2.3	-	-	-	-	-	-	-	-	-	-
B1	19.5-22	1	2	-	-	-	-	-	-	-	-	-	-
B2	24.5-27	2	3.6	-	-	-	-	-	-	-	-	-	-
B2	27-31	12	16	-	-	-	-	-	-	-	-	-	-
B2	9.5-12	2.4	14	-	-	-	-	-	-	-	-	-	-
B3	7-9.5	1.4	3.1	-	-	-	-	-	-	-	-	-	-
B4	2-4.5	1.2	0.9	-	-	-	-	-	-	-	-	-	-
B4	7-10	1.2	1.9	-	-	-	-	-	-	-	-	-	-
B5	20-22.5	10	24	-	-	-	-	-	-	-	-	-	-
B5	9-10.5	14	23	-	-	-	-	-	-	-	-	-	-
B6	24.5-27	11	24	-	-	-	-	-	-	-	-	-	-
B6	7-9.5	14	19	-	-	-	-	-	-	-	-	-	-
B7	24.5-27	14	25	-	-	-	-	-	-	-	-	-	-
B7	4.5-7	17	24	-	-	-	-	-	-	-	-	-	-
B8	24.5-27	20.0	26.0	-	-	-	-	-	-	-	-	-	-
B8	9.5-12.5	19.0	18.0	-	-	-	-	-	-	-	-	-	-
B9	12-15	12.0	24.0	-	-	-	-	-	-	-	-	-	-
B9	15-17	14.0	23.0	-	-	-	-	-	-	-	-	-	-
B10	14.5-17	13.0	24.0	-	-	-	-	-	-	-	-	-	-
B10	2.0-4.5	42.0	33.0	2.2	0.0	2.5	1.1	2.9	1.2	4.7	5.2	1.3	4.5
B11	14.5-17	10.0	25.0	-	-	-	-	-	-	-	-	-	-
B12	17.5-19	14.0	25.0	-	-	-	-	-	-	-	-	-	-
B12	7.5-10	9.0	26.0	-	-	-	-	-	-	-	-	-	-
B13	24.5-27	12.0	24.0	-	-	-	-	-	-	-	-	-	-
B14	2.5-5	20.0	25.0	-	-	-	-	-	-	-	-	-	-
B14	26.5-27.5	17.0	25.0	-	-	-	-	-	-	-	-	-	-
B15	10-12	10.0	28.0	-	-	-	-	-	-	-	-	-	-

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
B15	5-7.5	15.0	23.0	-	-	-	-	-	-	-	-	-	-
B17	17.5-19.2	16.0	26.0	-	-	-	-	-	-	-	-	-	-
B19	14.4-16.8	16.0	24.0	-	-	-	-	-	-	-	-	-	-
B19	2-3.4	14.0	20.0	-	-	-	-	-	-	-	-	-	-
B22	4.5-7	9.0	24.0	-	-	-	-	-	-	-	-	-	-
B22	9.5-12	14.0	23.0	-	-	-	-	-	-	-	-	-	-
B23	15.5-18	7.0	25.0	-	-	-	-	-	-	-	-	-	-
B23	23-25	16.0	28.0	-	-	-	-	-	-	-	-	-	-
B24	25-25.8	12.0	15 0	-	-	-	-	-	-	-	-	-	-
B24	9.5-12	12.0	24.0	-	-	-	-	-	-	-	-	-	-
B25	23.5-26.8	15.0	23.0	-	-	-	-	-	-	-	-	-	-
B25	9.6-12	19.0	26.0	-	-	-	-	-	-	-	-	-	-
B26	24.5-25.8	11.0	24.0	-	-	-	-	-	-	-	-	-	-
B27	12-14.5	9.0	26.0	-	-	-	-	-	-	-	-	-	-
B27	24.5-26.6	4.0	27.0	-	-	-	-	-	-	-	-	-	-
B28	24.5-25.1	6.0	19.0	-	-	-	-	-	-	-	-	-	-
B28	7-9.5	16.0	24.0	-	-	-	-	-	-	-	-	-	-
B29	24.5-25 5	9.0	21.0	-	-	-	-	-	-	-	-	-	-
B30	3 4-4.8	12.0	26.0	-	-	-	-	-	-	-	-	-	-
B31	7.5-9	21.0	31.0	-	-	-	-	-	-	-	-	-	-
B32	24-27	10.0	23.0	-	-	-	-	-	-	-	-	-	-
B32	7-9.5	20.0	18.0	-	-	-	-	-	-	-	-	-	-
B33	20-22.5	6.0	22.0	-	-	-	-	-	-	-	-	-	-
B33	4.0-7.5	51.0	38.0	3.0	0.1	3.4	2.4	5.1	2.9	6.5	10 4	3.1	4.2
B34	21-22	16.0	24.0	-	-	-	-	-	-	-	-	-	-
B34	7.5-10	17.0	28.0	-	-	-	-	-	-	-	-	-	-
B35	10-11	6.0	9.0	-	-	-	-	-	-	-	-	-	-
B35	11-12	27.0	28.0	-	-	-	-	-	-	-	-	-	-
B36	23-24.5	17.0	25.0	-	-	-	-	-	-	-	-	-	-

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
B36	9.0-11.0	360.0	130.0	18.0	0.9	18.0	20.0	30.0	21.0	36.9	71.0	20	27.2
B38	13-13.7	6.0	22.0	-	-	-	-	-	-	-	-	-	-
B38	2.5-5	9.0	20.0	-	-	-	-	-	-	-	-	-	-
B39	8-10	28.0	27.0	-	-	-	-	-	-	-	-	-	-
B46	5.1-7.7	11.0	24.0	-	-	-	-	-	-	-	-	-	-
B47	24.5-26.0	24.0	36.0	0.6	0.2	0.6	2.4	2.0	1.0	1.4	5.4	1.9	1.8
B48	12.5-15.0	24.0	33.0	1.3	0.0	2.0	1.7	2.9	1.5	3.3	6.1	1.8	3.5
B48	24.5-26	13.0	30.0	-	-	-	-	-	-	-	-	-	-
B49	17-19	10.0	23.0	-	-	-	-	-	-	-	-	-	-
B50	14.5-17	19.0	24.0	-	-	-	-	-	-	-	-	-	-
B51	24-26	17.0	26.0	-	-	-	-	-	-	-	-	-	-
B52	24-25.5	16.0	32.0	-	-	-	-	-	-	-	-	-	-
B53	23-24.9	13.0	29.0	-	-	-	-	-	-	-	-	-	-
B53	9-12.6	17.0	26.0	-	-	-	-	-	-	-	-	-	-
B54	19-21.8	14.0	25.0	-	-	-	-	-	-	-	-	-	-
B55	1.0-2.0	86.0	69.0	19.0	0.6	20.0	12.0	16.0	13.0	39.6	41.0	13	13.5
B55	17-19	13.0	24.0	-	-	-	-	-	-	-	-	-	-
B55	7.0-9.5	25.0	26.0	0.6	0.0	0.4	1.6	1.1	1.7	1.0	4.4	1.6	2.6
B56	12-14.5	18.0	20.0	-	-	-	-	-	-	-	-	-	-
B56	17-19	19.0	27.0	-	-	-	-	-	-	-	-	-	-
B57	24.5-27	16.0	33.0	-	-	-	-	-	-	-	-	-	-
B57	29.5-32	11.0	26.0	-	-	-	-	-	-	-	-	-	-
B58	14.5-17	12.0	25.0	-	-	-	-	-	-	-	-	-	-
B58	2.0-4.5	50.0	39.0	2.9	0.0	2.6	3.2	3.4	1.9	5.5	8.5	1.8	4.2
B59	12.5-15	59.0	62.0	19.0	2.0	23.0	0.9	3.1	1.0	44.0	5.0	0.68	0.0
B59	2.5-5	9.0	24.0	-	-	-	-	-	-	-	-	-	-
B60	15-17	18.0	21.0	-	-	-	-	-	-	-	-	-	-
B60	5-7.5	19.0	21.0	-	-	-	-	-	-	-	-	-	-
B61	15.0-17.0	25.0	25.0	1.7	0.0	1.8	1.2	1.1	1.0	3.5	3.3	1.4	2.2

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
B61	5.0-7.5	23.0	20.0	0.6	0.0	0.8	1.5	0.8	1.1	1.4	3.4	1.4	1.6
B62	10-12.5	19.0	30.0	-	-	-	-	-	-	-	-	-	-
B62	15.0-17.0	36.0	35.0	3.8	0.2	3.4	1.0	2.5	1.6	7.4	5.1	1.4	1.4
B63	12.5-15.0	22.0	29.0	0.7	0.0	0.7	0.9	1.3	1.0	1.4	3.2	1.2	2.0
B63	15.0-17.5	26.0	36.0	0.9	0.0	1.1	1.5	1.8	1.9	2.0	5.2	1.5	2.0
B64	18.0-20.0	44.0	40.0	1.7	0.2	1.8	2.1	1.6	1.4	3.7	5.1	2	2.4
B64	9.5-12.5	41.0	68.0	4.3	0.2	4.0	3.3	4.2	1.5	8.5	9.0	2	4.3
B65	15.0-17.5	110.0	56.0	0.3	0.0	0.7	2.5	3.6	1.6	1.0	7.7	2.5	16.0
B65	20.0-22.5	39.0	39.0	4.9	0.0	5.1	2.2	3.8	2.3	10.0	8.3	1.6	4.5
B66	17.5-20	17.0	24.0	-	-	-	-	-	-	-	-	-	-
B66	5.0-7.5	34.0	29.0	1.8	0.1	1.9	1.7	2.8	1.5	3.8	6.0	1.8	2.6
B67	2.5-5	8.0	24.0	-	-	-	-	-	-	-	-	-	-
B67	7.5-10	15.0	26.0	-	-	-	-	-	-	-	-	-	-
B68	2.5-5	6.0	21.0	-	-	-	-	-	-	-	-	-	-
B68	7.5-10	5.0	27.0	-	-	-	-	-	-	-	-	-	-
B69	5-7.5	9.0	23.0	-	-	-	-	-	-	-	-	-	-
B70	14-16.5	12.0	24.0	-	-	-	-	-	-	-	-	-	-
B70	5-7.5	9.0	22.0	-	-	-	-	-	-	-	-	-	-
B71	10-12.5	9.0	32.0	-	-	-	-	-	-	-	-	-	-
B71	7.5-10	8.0	24.0	-	-	-	-	-	-	-	-	-	-
B72	12.5-15.0	24.0	30.0	5.5	0.0	5.0	0.7	1.7	1.1	10.5	3.5	0.56	4.4
B72	15.0-16.0	120.0	100.0	44.0	2.3	47.0	0.9	0.9	0.7	93.3	2.5	1.3	1.3
B73	14.5-17	13.0	25.0	-	-	-	-	-	-	-	-	-	-
B73	2-4.5	13.0	19.0	-	-	-	-	-	-	-	-	-	-
B73	4.5-7.0	210.0	81.0	17.0	0.9	18.0	15.0	22.0	11.0	35.9	48.0	11	15.2
B74	10-12.5	16.0	24.0	-	-	-	-	-	-	-	-	-	-
MW-51S	14.5-17	1.5	3.5	-	-	-	-	-	-	-	-	-	-
MW-51S	27-29.5	1.4	3.3	-	-	-	-	-	-	-	-	-	-
MW-52S	14-17	8.0	19.0	-	-	-	-	-	-	-	-	-	-

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
MW-52S	3 5-7	9.0	26.0	-	-	-	-	-	-	-	-	-	-
MW-53S	23-25	15.0	32.0	-	-	-	-	-	-	-	-	-	-
MW-53S	25-27	16.0	28.0	-	-	-	-	-	-	-	-	-	-
MW-54S	2-4.5	20.0	24.0	-	-	-	-	-	-	-	-	-	-
MW-54S	24.5-27	12.0	21.0	-	-	-	-	-	-	-	-	-	-
MW-55S	14.5-17	10.0	23.0	-	-	-	-	-	-	-	-	-	-
MW-55S	7-9.5	11.0	26.0	-	-	-	-	-	-	-	-	-	-
MW-56S	14-17.5	16.0	25.0	-	-	-	-	-	-	-	-	-	-
MW-56S	3.5-5.5	12.0	24.0	-	-	-	-	-	-	-	-	-	-
MW-57S	10-12.5	13.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-57S	14-16.8	16.0	16.0	-	-	-	-	-	-	-	-	-	-
MW-58S	19-20	12.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-58S	7.5-9.5	11.0	27.0	-	-	-	-	-	-	-	-	-	-
MW-59S	4.5-7	1.7	1.7	-	-	-	-	-	-	-	-	-	-
MW-59S	9.5-12	0.8	1.0	-	-	-	-	-	-	-	-	-	-
MW-60S	2-4.5	12.0	20.0	-	-	-	-	-	-	-	-	-	-
MW-60S	9.5-12	19.0	21.0	-	-	-	-	-	-	-	-	-	-
MW-61S	14.5-17	1.2	1.0	-	-	-	-	-	-	-	-	-	-
MW-61S	7-9.5	0.9	0.5	-	-	-	-	-	-	-	-	-	-
MW-62S	12-14.5	1.0	2.9	-	-	-	-	-	-	-	-	-	-
MW-62S	7-9.5	1.7	2.4	-	-	-	-	-	-	-	-	-	-
MW-63S	22-24.5	0.7	1.7	-	-	-	-	-	-	-	-	-	-
MW-63S	9.5-12	1.6	2.6	-	-	-	-	-	-	-	-	-	-
MW-64S	14.5-17	8.0	22.0	-	-	-	-	-	-	-	-	-	-
MW-64S	2-4.5	17.0	28.0	-	-	-	-	-	-	-	-	-	-
MW-65S	10.0-12.0	41.0	30.0	4.1	0.0	4.7	1.5	1.6	1.1	8.8	4.2	2.6	8.0
MW-65S	23.5-26.2	7.0	22.0	-	-	-	-	-	-	-	-	-	-
MW-66S	14.5-17	0.5	1.9	-	-	-	-	-	-	-	-	-	-
MW-66S	4.5-7	1.5	4.3	-	-	-	-	-	-	-	-	-	-

Table 4-3
Subsurface Soil Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)											
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Total Uranium ¹	Total Thorium ²	Ra-228 ³	Ra-226 ⁴
MW-67S	12-14.5	1.5	5.4	-	-	-	-	-	-	-	-	-	-
MW-67S	19.5-22	1.4	2.6	-	-	-	-	-	-	-	-	-	-
MW-67S	22-24.5	22.0	13.0	-	-	-	-	-	-	-	-	-	-
MW-68S	14.5-17	14.0	21.0	-	-	-	-	-	-	-	-	-	-
MW-68S	2-4.5	11.0	25.0	-	-	-	-	-	-	-	-	-	-
MW-69S	10.5-13	2.0	24.0	-	-	-	-	-	-	-	-	-	-
MW-69S	3-5.5	8.0	23.0	-	-	-	-	-	-	-	-	-	-
MW-70S	19.5-22	1.4	2.0	-	-	-	-	-	-	-	-	-	-
MW-70S	9.5-12	2.0	4.0	-	-	-	-	-	-	-	-	-	-
MW-71S	17.0-19.5	160.0	98.0	54.0	2.3	59.0	0.8	0.4	0.8	115.3	2.0	1.1	8.3
MW-71S	19.5-22.0	21.0	28.0	2.2	0.3	1.7	0.6	1.5	1.1	4.2	3.2	0.64	0.0
MW-72S	4.5-7	3.0	4.8	-	-	-	-	-	-	-	-	-	-
MW-72S	7-9.5	4.0	6.3	-	-	-	-	-	-	-	-	-	-
MW-73S	13-14.2	1.7	1.0	-	-	-	-	-	-	-	-	-	-
MW-73S	9.5-12	1.5	3.1	-	-	-	-	-	-	-	-	-	-
MW-74S	12-15	9.0	18.0	-	-	-	-	-	-	-	-	-	-
MW-74S	2-4.5	18.0	26.0	-	-	-	-	-	-	-	-	-	-
MW-75S	4.5-7	2.0	26.0	-	-	-	-	-	-	-	-	-	-
Min:		0.5	0.5	0.3	0.0	0.4	0.6	0.4	0.7	1.0	2.0	0.6	0.0
Max:		360.0	130.0	54.0	2.3	59.0	20.0	30.0	21.0	115.3	71.0	20.0	27.2
Avg:		19.6	24.2	8.6	0.4	9.2	3.3	4.7	3.0	18.1	11.1	3.2	5.5
Std Dev:		36.7	17.2	13.7	0.7	14.9	4.9	7.2	4.8	29.2	16.7	4.6	6.3
Count:		162	162	25	25	25	25	25	25	25	25	25	25

Footnotes:

- ¹ Total Uranium = U-238 + U-235 + U-234.
² Total Thorium = Th-232 + Th-230 + Th-228.
³ Ra-228 activity inferred from Ac-228 activity identified by gamma spectroscopy.
⁴ Ra-226 activity adjusted for presence of U-235 activity (gamma spectroscopy based on ratio of 186 keV gamma yields) = Ra-226 - (U-235 x (0.54/0.038)).

Table 4-4
Subsurface Soil Sample Results - Activity Ratios
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)								Ratios					
		U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-228 ¹	Ra-226 ²	U-234/U-238	Th-230/U-238	Ra-226/U-238	Th-228/Th-232	Ra-228/Th-232	U-238/Th-232
B10	2.0-4.5	2.2	0.0	2.5	1.1	2.9	1.2	1.3	4.5	0.88	1.16	1.80	0.92	1.08	2.08
B33	4.0-7.5	3.0	0.1	3.4	2.4	5.1	2.9	3.1	4.2	0.88	1.50	1.23	0.83	1.07	1.17
B36	9 0-11.0	18 0	0.9	18.0	20.0	30.0	21.0	20	27.2	1.00	1.67	1.51	0.95	0.95	0.86
B47	24.5-26.0	0.6	0.2	0.6	2.4	2.0	1.0	1.9	1.8	1.00	3.33	2.93	2.40	1.90	0.60
B48	12.5-15.0	1.3	0.0	2.0	1.7	2.9	1.5	1.8	3.5	0.65	1.45	1.75	1.13	1.20	1.33
B55	1.0-2 0	19.0	0.6	20.0	12.0	16.0	13.0	13	13.5	0.95	0.80	0.67	0.92	1.00	1.54
B55	7.0-9.5	0.6	0.0	0.4	1.6	1.1	1.7	1.6	2.6	1.50	2.75	6.50	0.94	0.94	0.24
B58	2 0-4.5	2.9	0.0	2.6	3 2	3.4	1.9	1.8	4.2	1.12	1.31	1.62	1.68	0.95	1.37
B59	12.5-15	19.0	2.0	23.0	0.9	3.1	1.0	0 68	0.0	0.83	0.13	0.00	0.90	0.68	23.00
B61	15 0-17.0	1.7	0.0	1.8	1.2	1.1	1.0	1.4	2.2	0.94	0.61	1.22	1.20	1.40	1.80
B61	5 0-7.5	0.6	0.0	0.8	1.5	0.8	1.1	1.4	1.6	0.75	1.00	2.00	1.36	1.27	0.73
B62	15.0-17.0	3.8	0.2	3.4	1.0	2.5	1.6	1.4	1.4	1.12	0.74	0.40	0.63	0 88	2.13
B63	12.5-15 0	0.7	0.0	0.7	0.9	1.3	1.0	1.2	2.0	1.00	1.86	2.86	0.90	1.20	0.70
B63	15.0-17.5	0.9	0.0	1.1	1.5	1.8	1.9	1.5	2.0	0.82	1.64	1.82	0.79	0.79	0.58
B64	18.0-20.0	1.7	0.2	1.8	2.1	1.6	1.4	2	2.4	0.94	0.89	1.31	1.50	1.43	1.29
B64	9.5-12.5	4.3	0.2	4.0	3.3	4.2	1.5	2	4.3	1.08	1.05	1.06	2.20	1.33	2.67
B65	15.0-17.5	0.3	0.0	0.7	2.5	3.6	1.6	2.5	16.0	0.43	5.14	22.86	1.56	1.56	0.44
B65	20.0-22.5	4.9	0.0	5.1	2.2	3.8	2.3	1.6	4.5	0.96	0.75	0.88	0.96	0.70	2.22
B66	5.0-7.5	1.8	0.1	1.9	1.7	2.8	1.5	1.8	2.6	0.95	1.47	1.36	1.13	1.20	1.27
B72	12.5-15.0	5.5	0.0	5.0	0.7	1.7	1.1	0.56	4.4	1.10	0.34	0.88	0.64	0.51	4.55
B72	15.0-16.0	44.0	2.3	47.0	0.9	0.9	0.7	1.3	1.3	0.94	0 02	0.03	1.29	1.86	67.14
B73	4.5-7.0	17.0	0.9	18.0	15.0	22.0	11.0	11	15.2	0.94	1.22	0.85	1.36	1.00	1.64
MW-65S	10.0-12.0	4.1	0.0	4.7	1.5	1.6	1.1	2.6	8.0	0.87	0.34	1.70	1.36	2.36	4.27
MW-71S	17.0-19.5	54.0	2.3	59.0	0.8	0.4	0.8	1.1	8.3	0.92	0.01	0.14	1.00	1.38	73.75
MW-71S	19.5-22.0	2.2	0.3	1.7	0.6	1.5	1.1	0.64	0.0	1.29	0.88	0.00	0.55	0.58	1.55
Min:		0.3	0.0	0.4	0.6	0.4	0.7	0.6	0.0	0.4	0.0	0.0	0.5	0.5	0.2
Max:		54.0	2.3	59.0	20.0	30.0	21.0	20.0	27.2	1.5	5.1	22.9	2.4	2.4	73.8
Avg:		8.6	0.4	9.2	3.3	4.7	3.0	3.2	5.5	1.0	1.3	2.3	1.2	1.2	8.0
Std Dev:		13.7	0.7	14.9	4.9	7.2	4.8	4.6	6 3	0.2	1.1	4.5	0.5	0.4	19.3
Count:		25	25	25	25	25	25	25	25	25	25	25	25	25	25

Footnotes:
¹ Ra-228 activity inferred from Ac-228 activity identified by gamma spectroscopy.
² Ra-226 activity adjusted for presence of U-235 activity (gamma spectroscopy based on ratio of 186 keV gamma yields) = Ra-226 - (U-235 x (0 54/0 038)).

Table 4-5
Pond 2 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)			Concentration (pCi/g)								Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P2-1A	0-4	2300	920	180	5.8	180	160	640	160	160	155	3.56	0.86	1.00	31.03	1.13
P2-1B	4-8	4800	2400	510	19	530	340	780	340	340	227	1.47	0.43	0.96	27.89	1.56
P2-1C	8-12.5	3200	2000	410	22	430	260	850	260	260	138	1.98	0.32	0.95	19.55	1.65
P2-2A	0-3	6200	2700	440	19	440	500	650	500	500	277	1.48	0.63	1.00	23.16	0.88
P2-2B	3-6	3200	1500	170	5.3	170	250	420	250	250	223	2.47	1.31	1.00	32.08	0.68
P2-2C	6-9	5200	2200	290	13	280	450	670	450	450	316	2.39	1.13	1.04	21.54	0.62
P2-3A	0-4	4900	2200	320	11	350	420	710	420	420	329	2.03	0.94	0.91	31.82	0.83
P2-3B	4-8	6700	3100	550	29	580	560	690	560	560	243	1.19	0.42	0.95	20.00	1.04
P2-3C	8-12	3800	1800	230	13	250	300	860	300	300	186	3.44	0.74	0.92	19.23	0.83
Min:		2300.0	920.0	170.0	5.3	170.0	160.0	420.0	160.0	160.0	137.8	1.2	0.3	0.9	19.2	0.6
Max:		6700.0	3100.0	550.0	29.0	580.0	560.0	860.0	560.0	560.0	328.9	3.6	1.3	1.0	32.1	1.7
Avg:		4477.8	2091.1	344.4	15.2	356.7	360.0	696.7	360.0	360.0	232.5	2.2	0.8	1.0	25.1	1.0
Std Dev:		1465.2	644.4	140.2	7.7	148.2	131.1	132.3	131.1	131.1	66.8	0.8	0.3	0.0	5.5	0.4
Number:		9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-6
Pond 3 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)			Concentration (pCi/g)								Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P3-1A	0-5	5800	2700	570	20	580	470	770	470	470	400.7	1.33	0.69	0.98	29.00	1.23
P3-1B	5-10	5200	2900	860	46	910	450	780	450	450	-87.3	0.86	-0.10	0.95	19.78	2.02
P3-1C	10-16	7600	3800	950	43	1000	600	800	600	600	152.1	0.80	0.15	0.95	23.26	1.67
P3-2A	0-5	3400	1800	290	14	290	360	790	360	360	259.5	2.72	0.89	1.00	20.71	0.81
P3-2B	5-10	5500	2500	650	33	710	420	1100	420	420	66.7	1.55	0.09	0.92	21.52	1.69
P3-2C	10-15	6300	3100	800	45	870	450	1200	450	450	99.1	1.38	0.11	0.92	19.33	1.93
P3-3A	0-5	5400	2900	510	30	560	520	950	520	520	226.1	1.70	0.40	0.91	18.67	1.08
P3-3B	5-10	3300	1700	420	42	460	290	690	290	290	-141.5	1.50	-0.31	0.91	10.95	1.59
P3-3C	10-13	5500	2700	340	14	340	470	920	470	470	359.5	2.71	1.06	1.00	24.29	0.72
P3-4A	0-3	5900	2700	420	22	430	400	700	400	400	297.8	1.63	0.69	0.98	19.55	1.08
P3-4B	3-6	6400	3700	820	32	850	530	850	530	530	153.2	1.00	0.18	0.96	26.56	1.60
P3-4C	6-9	6900	3800	1000	41	1100	680	810	680	680	145.0	0.74	0.13	0.91	26.83	1.62
P3-5A	0-3	6500	3100	820	39	870	470	430	470	470	97.9	0.49	0.11	0.94	22.31	1.85
P3-5B	3-6	840	610	170	12	180	94	210	94	94	-27.6	1.17	-0.15	0.94	15.00	1.91
P3-5C	6-9	4400	2100	350	20	370	350	490	350	350	150.7	1.32	0.41	0.95	18.50	1.06
Min:		840.0	610.0	170.0	12.0	180.0	94.0	210.0	94.0	94.0	-141.5	0.5	-0.3	0.9	11.0	0.7
Max:		7600.0	3800.0	1000.0	46.0	1100.0	680.0	1200.0	680.0	680.0	400.7	2.7	1.1	1.0	29.0	2.0
Avg:		5262.7	2674.0	598.0	30.2	634.7	436.9	766.0	436.9	436.9	143.5	1.4	0.3	0.9	21.1	1.5
Std Dev:		1700.9	861.4	263.8	12.3	286.9	136.1	250.3	136.1	136.1	153.7	0.6	0.4	0.0	4.6	0.4
Number:		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-7
Pond 5 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)										Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/U-238	Ra-226/U-238	U-234/U-238	U-238/U-235	U-238/Th-232
P5-1A	-	190	88	28.0	1.4	28.0	7.5	12.0	7.5	7.5	4.0	0.43	0.14	1.00	20.00	3.73
P5-1B	-	170	170	97.0	5.0	97.0	4.7	8.8	4.7	4.7	-25.3	0.09	-0.26	1.00	19.40	20.64
P5-1C	-	19	17	3.9	0.0	2.7	0.9	1.2	0.9	0.9	2.9	0.44	1.07	1.44	NA	3.03
P5-2A	0-1.45	44	34	4.1	0.1	4.1	2.7	2.8	2.7	2.7	3.6	0.68	0.87	1.00	41.00	1.52
P5-2B	1.45-3	130	52	10.0	0.6	10.0	7.5	11.0	7.5	7.5	4.1	1.10	0.41	1.00	16.67	1.33
P5-2C	3-4.45	390	140	36.0	1.5	39.0	24.0	38.0	24.0	24.0	16.3	0.97	0.42	0.92	26.00	1.63
P5-3A	0-1.6	84	31	6.8	0.1	7.0	4.3	7.3	4.3	4.3	7.7	1.04	1.09	0.97	70.00	1.63
P5-3B	1.6-3.2	40	21	2.3	0.1	2.6	1.8	1.2	1.8	1.8	1.6	0.46	0.60	0.88	26.00	1.44
P5-3C	3.2-4.9	16	22	0.6	0.0	0.4	1.3	0.4	1.3	1.3	1.7	1.00	4.25	1.50	NA	0.31
Min:		16.0	17.0	0.6	0.0	0.4	0.9	0.4	0.9	0.9	-25.3	0.1	-0.3	0.9	16.7	0.3
Max:		390.0	170.0	97.0	5.0	97.0	24.0	38.0	24.0	24.0	16.3	1.1	4.3	1.5	70.0	20.6
Avg:		120.3	63.9	21.0	1.0	21.2	6.1	9.2	6.1	6.1	1.8	0.7	1.0	1.1	31.3	3.9
Std Dev:		119.8	56.5	31.1	1.6	31.3	7.2	11.7	7.2	7.2	11.1	0.4	1.3	0.2	18.8	6.3
Number:		9	9	9	9	9	9	9	9	9	9	9	9	9	7	9

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-8
Pond 6 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)										Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P6-1	0-3	110	55	8.4	0.3	8.6	4.5	8.2	4.5	4.5	7.1	0.95	0.82	0.98	28.67	1.91
P6-2	0-3	150	67	17.0	2.4	19.0	4.6	8.0	4.6	4.6	-24.5	0.42	-1.29	0.89	7.92	4.13
	Min:	110.0	55.0	8.4	0.3	8.6	4.5	8.0	4.5	4.5	-24.5	0.4	-1.3	0.9	7.9	1.9
	Max:	150.0	67.0	17.0	2.4	19.0	4.6	8.2	4.6	4.6	7.1	1.0	0.8	1.0	28.7	4.1
	Avg:	130.0	61.0	12.7	1.4	13.8	4.6	8.1	4.6	4.6	-8.7	0.7	-0.2	0.9	18.3	3.0
	Std Dev:	28.3	8.5	6.1	1.5	7.4	0.1	0.1	0.1	0.1	22.3	0.4	1.5	0.1	14.7	1.6
	Number:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-9
Pond 7 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)			Concentration (pCi/g)								Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P7-1	0-3	310	130	26.0	1.3	25.0	15.0	24.0	15.0	15.0	10.6	0.96	0.42	1.04	19.23	1.67
P7-2	0-3	680	270	74.0	3.9	81.0	37.0	54.0	37.0	37.0	27.8	0.67	0.34	0.91	20.77	2.19
	Min:	310.0	130.0	26.0	1.3	25.0	15.0	24.0	15.0	15.0	10.6	0.7	0.3	0.9	19.2	1.7
	Max:	680.0	270.0	74.0	3.9	81.0	37.0	54.0	37.0	37.0	27.8	1.0	0.4	1.0	20.8	2.2
	Avg:	495.0	200.0	50.0	2.6	53.0	26.0	39.0	26.0	26.0	19.2	0.8	0.4	1.0	20.0	1.9
	Std Dev:	261.6	99.0	33.9	1.8	39.6	15.6	21.2	15.6	15.6	12.2	0.2	0.1	0.1	1.1	0.4
	Number:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-10
Pond 8 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)										Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P8-1A	0-7	300	190.0	74.0	2.7	73.0	12.0	14.0	12	12.0	12.5	0.19	0.17	1.01	27.04	6.08
P8-1B	7-14	150	82.0	28.0	1.1	31.0	6.2	12.0	6.2	6.2	7.9	0.39	0.25	0.90	28.18	5.00
P8-1C	14-21	240	110.0	32.0	1.4	34.0	8.3	24.0	8.3	8.3	9.0	0.71	0.26	0.94	24.29	4.10
P8-2A	0-9	120	63.0	16.0	1.1	17.0	5.5	10.0	5.5	5.5	0.9	0.59	0.05	0.94	15.45	3.09
P8-2B	9-14	160	59.0	9.6	0.7	9.9	10.0	13.0	10	10.0	1.5	1.31	0.15	0.97	14.14	0.99
P8-2C	14-20	360	150.0	25.0	1.6	25.0	23.0	29.0	23	23.0	4.7	1.16	0.19	1.00	15.63	1.09
P8-3A	0-9	210	100.0	39.0	1.5	42.0	8.8	12.0	8.8	8.8	11.3	0.29	0.27	0.93	28.00	4.77
P8-3B	9-18	120	76.0	25.0	0.8	27.0	4.5	6.8	4.5	4.5	11.8	0.25	0.44	0.93	33.75	6.00
P8-3C	18-27	290	110.0	20.0	1.2	20.0	18.0	21.0	18	18.0	8.2	1.05	0.41	1.00	16.67	1.11
P8-4A	0-9	170	88.0	33.0	1.9	33.0	6.3	9.9	6.3	6.3	-0.3	0.30	-0.01	1.00	17.37	5.24
P8-4B	9-18	120	81.0	31.0	1.0	31.0	4.5	7.7	4.5	4.5	11.5	0.25	0.37	1.00	31.00	6.89
P8-4C	18-27	300	120.0	20.0	0.7	21.0	16.0	20.0	16	16.0	15.5	0.95	0.74	0.95	30.00	1.31
P8-5A	0-7	160	76.0	30.0	1.6	30.0	6.4	7.4	6.4	6.4	1.7	0.25	0.06	1.00	18.75	4.69
P8-5B	7-16	140	72.0	19.0	1.5	21.0	5.4	7.8	5.4	5.4	-6.7	0.37	-0.32	0.90	14.00	3.89
P8-5C	16-24	310	130.0	23.0	1.2	24.0	23.0	14.0	23	23.0	12.2	0.58	0.51	0.96	20.00	1.04
Min:		120.0	59.0	9.6	0.7	9.9	4.5	6.8	4.5	4.5	-6.7	0.2	-0.3	0.9	14.0	1.0
Max:		360.0	190.0	74.0	2.7	73.0	23.0	29.0	23.0	23.0	15.5	1.3	0.7	1.0	33.8	6.9
Avg:		210.0	100.5	28.3	1.3	29.3	10.5	13.9	10.5	10.5	6.8	0.6	0.2	1.0	22.3	3.7
Std Dev:		82.5	35.8	14.7	0.5	14.4	6.5	6.7	6.5	6.5	6.2	0.4	0.2	0.0	6.9	2.1
Number:		15	15	15	15	15	15	15	15	15	15	15	15	15	15	15

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-11
Pond 9 Residue Sample Results
1993 Remediation Assessment Data

Sample ID	Depth Interval (ft)	Concentration (pCi/g)										Ratios				
		Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228 ¹	Th-230	Th-232 ¹	Ra-228 ¹	Ra-226 ²	Th-230/ U-238	Ra-226/ U-238	U-234/ U-238	U-238/ U-235	U-238/ Th-232
P9-1A	0-6	77	49.0	12.0	1.6	15.0	5.4	13.0	5.4	5.4	-12.3	0.87	-0.82	0.80	9.38	2.78
P9-1B	6-11	50	50.0	24.0	1.1	24.0	1.4	4.1	1.4	1.4	-3.1	0.17	-0.13	1.00	21.82	17.14
P9-1C	11-16	21	33.0	11.0	0.4	11.0	1.4	3.3	1.4	1.4	1.4	0.30	0.13	1.00	27.50	7.86
P9-2A	0-8	82	91.0	42.0	1.9	43.0	3.6	14.0	3.6	3.6	-1.3	0.33	-0.03	0.98	22.63	11.94
P9-3A	0-9	44	54.0	21.0	1.2	25.0	1.6	0.9	1.6	1.6	-5.8	0.04	-0.23	0.84	20.83	15.63
P9-3B	9-16	30	24.0	7.1	0.6	7.6	0.6	2.4	0.58	0.6	-6.1	0.32	-0.80	0.93	12.67	13.10
P9-3C	16-24	30	32.0	10.0	0.5	11.0	0.8	9.0	0.77	0.8	-0.3	0.82	-0.03	0.91	22.00	14.29
P9-4A	0-8	100	100.0	53.0	2.8	57.0	4.0	10.0	4	4.0	-6.1	0.18	-0.11	0.93	20.36	14.25
P9-4B	8-16	37	32.0	11.0	0.8	13.0	0.0	1.6	0	0.0	-3.7	0.12	-0.28	0.85	16.25	NA
P9-4C	16-25	51	48.0	16.0	0.5	17.0	2.1	4.3	2.1	2.1	2.8	0.25	0.16	0.94	34.00	8.10
P9-5B	9-17	34	38.0	11.0	1.2	14.0	1.1	1.0	1.1	1.1	-10.4	0.07	-0.74	0.79	11.67	12.73
P9-5C	17-25	60	50.0	21.0	4.0	26.0	2.7	4.9	2.7	2.7	-52.9	0.19	-2.03	0.81	6.50	9.63
Min:		21.0	24.0	7.1	0.4	7.6	0.0	0.9	0.0	0.0	-52.9	0.0	-2.0	0.8	6.5	2.8
Max:		100.0	100.0	53.0	4.0	57.0	5.4	14.0	5.4	5.4	2.8	0.9	0.2	1.0	34.0	17.1
Avg:		51.3	50.1	19.9	1.4	22.0	2.1	5.7	2.1	2.1	-8.1	0.3	-0.4	0.9	18.8	11.6
Std Dev:		24.2	23.3	14.1	1.1	14.7	1.6	4.6	1.6	1.6	14.8	0.3	0.6	0.1	7.9	4.2
Number:		12	12	12	12	12	12	12	12	12	12	12	12	12	12	11

Footnotes:
¹ Ra-228, Th-228 and Th-232 inferred from Ac-228 activity on gamma spectroscopy report.
² Ra-226 gamma spectroscopy result adjusted for U-235 activity identified by gamma spectroscopy.

Table 4-12
Summary of 1993 Characterization Results
Surface Water Samples

Sample ID	Concentration (pCi/l)									
	Gross Alpha	Gross Beta	U-234	U-235	U-238	Th-228	Th-230	Th-232	Ra-226	Ra-228
SS-001	4	8								
SS-002	45	70	8.3	0.5	8.2	1.8	1.3	1.8	3.4	1.5
SS-003	2	4								
SS-005	3	7								
SS-1	110	150	8.9	-0.1	5.4	14	8.6	17.0	5.9	11.0
SS-2	2	7								
SS-3	3	8								
Min:	2.0	4.0	8.3	-0.1	5.4	1.8	1.3	1.8	3.4	1.5
Max:	110.0	150.0	8.9	0.5	8.2	14.0	8.6	17.0	5.9	11.0
Avg:	27.5	41.0	8.6	0.2	6.8	7.9	5.0	9.4	4.7	6.3
Std Dev	43.8	59.1	0.4	0.4	2.0	8.6	5.2	10.7	1.8	6.7

Figures

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**DRAWING NO. 6473425, FIGURE 4-1,
FACILITY LAYOUT, BORING AND
WELL LOCATION MAP
DECOMMISSIONING PLAN
FANSTEEL INC.
MUSKOGEE, OKLAHOMA**

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D-01

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CHEM-C BUILDING LAYOUT
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DECOMMISSIONING PLAN
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CHEM A BUILDING 2nd FLOOR
AND 3rd FLOOR
DECOMMISSIONING PLAN
FANSTEEL, INC.
MUSKOGEE, OKLAHOMA**

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CHEM A BUILDING 3rd FLOOR LAB
DECOMMISSIONING PLAN
FANSTEEL, INC.
MUSKOGEE, OKLAHOMA**

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D-05

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CHEM A BUILDING 4th FLOOR
DECOMMISSIONING PLAN
FANSTEEL, INC.
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D-06